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RESEARCH INSTITUTE, NEW DELHI.

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OF

NEW SOUTH WALES.

FOR THE YEAR

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WITH FIFTY PLATES.

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PROCEEDINGS

OF THE

LINNEAN SOCIETY

OF

NEW SOUTH WALES.

WEDNESDAY, MARCH 25TH, 1903

The Ordinary Monthly Meeting of the Society was held in the Linnean Hall, Ithaca Road, Elizabeth Bay, on Wednesday evening, March 25th, 1903.

Dr. T. Storie Dixson, President, in the Chair.

Messrs. H. J. CARTER, B.A., "Ascham," Darling Point; A. F. MIXNER, M.I.A.M.E., Homeward Bound Mine, Yalwal, N.S.W.; and G. F. VAUGHAN, M.A., Sydney Grammar School, were elected Members of the Society.

The Donations and Exchanges received since the previous Monthly Meeting (26th November, 1902), amounting to 33 Vols., 222 Parts or Nos., 33 Bulletins, 35 Reports, 4 Pamphlets, 6 Maps and Charts, and 18 Miscellanea, received from 110 Societies, &c., and 3 Individuals, were laid upon the table.

A MONOGRAPH OF THE AUSTRALIAN *MEMBRACIDÆ.*

By F. W. Goding, M.D., Ph.D.

(Plate i.)

Introduction.

The *Membracidæ* are distinguished from the other Homoptera by the perpendicular head, the wonderful development and prolongation posteriorly of the prothorax, and the venation of the tegmina and wings, although all of these characters are more or less modified, gradually passing to those of closely related groups. An example of variation in the form of the head is seen in *Porcorhinus*, where it is horizontal and shovel-shaped, while in the prothorax the posterior process may be absent as in the same genus. The normal number of veins passing from the base of the corium is three, yet in some of the genera there is but one.

The head is usually perpendicular; when viewed from the front it is triangular, quadrilateral, or bandeau-shaped, with the large globular eyes on each side of the base, between which are the ocelli. The prothorax usually covers the chest and abdomen, but in all the Australian forms examined by me the scutellum is more or less exposed. Above the attachments of the tegmina are the lateral angles, which may be prominent or obsolete. The dorsum may be convex, tectiform, flat or elevated in protuberances or horns, and extends, posteriorly, in a variously shaped process, which, however, may be absent, and nearly always there is present a percurrent median longitudinal carina. When the posterior process is absent, the scutellum frequently is furnished with horns or spines, and in form it is usually triangular, the apex terminating in one or two small teeth. The tegmina (upper wings) are more or less lanceolate, and are divided into two distinct parts, the corium and the clavus. The former occupies the greater portion, and has, arising from the base, the costa and three longitudinal veins, the radial and two ulnar, which are forked to form, with transverse venules, the variously formed cells. These are usually the costal, radial, two ulnar, one or more discoidal (these may be absent), and five apical cells, the last a distinguishing characteristic of this group. The clavus occupies the interior of the tegmina, being separated from the corium by a suture, which is represented in the plate of this work by dotted lines. It has one or two veins arising from the base, and may have the sides parallel or gradually narrowed to the apex. The tegmina may be free, or more or less covered by the lateral borders of the posterior process of the prothorax, the free part more or less coriaceous and opaque. They are surrounded by a margin which may be very narrow, the veins even reaching the edges, or very broad, occupying nearly one-half of the tegmina. The wings (lower wings) are also divided into two parts, the corium and clavus, the former having the costa and three longitudinal veins arising from the base, forming three basal and three or more apical cells, while the clavus may have one or two basal veins. They are always vitreous, iridescent, and transparent. The legs consist of the femora, tibiæ, and tarsi. The femur is cylindrical and curved, the tibia quadrangular, prismatic or spatulate, while the tarsus is composed of three articles, the first long, the other two short, the last ending in two claws.

As regards the habits of the *Membracidæ* all that need be mentioned is well told by Mr. Froggatt in an article which is copied in these pages under *S. virescens* (p. 11).

I take great pleasure in acknowledging assistance received in the way of material, copies of papers, and words of encouragement from Messrs. W. W. Froggatt, Charles French, Charles French, Junr., Henry Tryon, A. M. Lea, J. G. O. Tepper, J. A. Kershaw, A. Simson, George Masters, and George Lyell, Junr.; also to Mr. A. D. Chater for the drawings. To Captain F. W.

Hutton, Christchurch, N.Z., I am indebted for information as to the *Membracidæ* not having been found in that Colony.

In working out the identity of the described Australian species, great difficulty was experienced, owing to the meagreness and indefiniteness of the published descriptions of Walker and Fairmaire. Stal experienced the same trouble, and practically refused to recognise Walker's work. However, in this I believe him to have erred. Where a species can be identified from the description, illustration, or type, I always recognise it; hence I believe that the synonymy as given in the following pages is correct.

When sufficient material shall have been collected to form a complete duplicate series, my types of the Australian forms will be deposited in some Museum in this Commonwealth for the benefit of students.

Species preceded by an asterisk (*) are in my collection.

Check List of Australian Membracidæ.

Terentius, Stal.
1. *convexus*, Stal.
Dingkana, Godg.
2. *borealis*, Godg.
Sextius, Stal.
3. *bipunctatus*, Fabr.
4. *depressus*, Godg.
5. *virescens*, Fairm.
C. suffusa, Walk.
Acanthucus, Stal.
6. *rufiventris*, Walk.
7. *trispinifer*, Fairm.
8. *gracilispinus*, Stal.
9. *conspurcatus*, Stal.
10. *bispinus*, Stal.
11. *Kershawi*, Godg.
Sertorius, Stal.
12. *australis*, Fairm.
C. obstans, Walk.
C. binotatus, Walk.
13. *acanthaspis*, Fairm.
C. decisus, Walk.
14. *giganticus*, Godg.
15. *brevicornis*, Godg.
16. *Tepperi*, Godg.
17. *areolatus*, Godg.
18. *curvicaudus*, Godg.
Eufrenchia.
19. *falcata*, Walk.
S. curvicornis, Stal.
20. *Leæ*, Godg.

CENTROTYPUS, Stal.
21. *occidentalis*, Godg.
22. *minutus*, Godg.
LUBRA, Godg.
23. *spinicornis*, Walk.
24. *regalis*, Godg.
DAUNUS, Stal.
25. *vitta*, Walk.
O. contorta, Walk.
26. *Tasmaniæ*, Fairm.
C. contractus, Walk.
C. truncaticornis, Walk.
27. *gracilis*, Godg.
EUTRYONIA, Godg.
28. *monstrifera*, Walk.
O. ponderifer, Walk.
(?) HYPSOPHORA, Stal.
29. *cassis*, Buck.
(?) PHILYA, Walk.
30. *parvula*, Buck.
EUFROGGATTIA, Godg.
31. *tuberculata*, Godg.
PORCORHINUS, Godg.
32. *Mastersi*, Godg.

SYNOPSIS OF SUBFAMILIES OF THE MEMBRACIDÆ.

1 (2) Scutellum distinct, produced beyond metanotum, and furnished with acute apical angles .... *Centrotinæ*.
2 (1). Scutellum obsolete or wanting, not extending beyond metanotum.
3 (10). Tarsi of equal length, or posterior longer than anterior pairs.
4 (9). Tibiæ simple, not dilated.
5 (6). Tegmina folded behind clavus, free portion coriaceous, opaque, with scarcely distinguishable veins externally; clavus and interior basal cell of corium broadened toward apex, intermediate apical cell petiolate in the coriaceous part ...... *Tragopinæ*.
6 (5). Tegmina entirely membranous; veins distinct.
7 (8). Third apical cell elongate, never petiolate............ *Darninæ*.
8 (7). Third apical cell subtriangular, petiolate adjacent cells contiguous .... *Smiliinæ*.
9 (4). Tibiæ and lateral borders of head dilated, foliaceous. *Membracinæ*.
10 (3). Posterior tarsi small, shorter than anterior pairs..... *Hoplophorinæ*.

SYNOPSIS OF THE GENERA FOUND IN AUSTRALIA.

1 (24). Prothorax furnished with a posterior process which nearly covers scutellum.
2 (5). Dorsum of prothorax unarmed, convex.
3 (4). Corium with two discoidal cells................... *Terentius*, p. 7.
4 (3). Corium with three discoidal cells................. *Dingkana*, p. 8.

5 (2). Dorsum of prothorax armed with one or more horns or protuberances.

6 (11). Dorsum in front, furnished with one protuberance.

7 (10). Dorsal protuberance erect, much thickened, gibbous posteriorly near base.

8 (7). Apex of dorsal protuberance much dilated on each side, exteriorly a sharp, slender, directly diverging spine... *Eutryonia*, p. 34.

9 (8). Apex of dorsal protuberance not dilated laterally, destitute of lateral spines... *Hypsoprora*, p. 35.

10 (7). Dorsal protuberance porrect, slightly ascending *Philya*, p. 36.

11 (6). Dorsum of prothorax with two or more protuberances or horns.

12 (23). Dorsum with two horns, one over each lateral angle.

13 (16). Lateral horns dilated at apices; more or less erect, contiguous at base.

14 (15). Apices of lateral horns reticulate, exteriorly with a spine; interior angle acuminate or gibbous, sometimes forming an arch... *Lubra*, p. 28.

15 (14). Apices of lateral horns not reticulate, and destitute of exterior spines but acuminate, the interior angle not gibbous... *Daunus*, p. 30.

16 (13). Lateral horns not dilated at apices, more or less acuminate.

17 (18). Tibiæ dilated, venation in apical part of corium very irregular, forming many cellules; posterior process tectiform... *Sextius*, p. 9.

18 (17). Tibiæ not dilated (one exception); venation regular (one exception, third apical cell divided); posterior process not tectiform.

19 (22). Two ulnar veins joined, near base, with a transverse venule.

20 (21). Corium with two discoidal cells... *Sertorius*, p. 18.

21 (20). Corium with three discoidal cells... *Eufrenchia*, p. 24.

22 (19). Two ulnar veins, not joined, near base, with a transverse venule... *Centrotypus*, p. 26.

23 (12). Dorsum with three protuberances or horns, lateral horns, conical, acuminate; the third placed on the median carina is a triangular pine or angle, or median carina lightly and briefly foliaceous... *Acanthucus*, p. 13.

24 (1). Prothorax destitute of a posterior process; scutellum everywhere visible.

25 (26). Scutellum short, triangular; head produced in a large shovel-shaped form; venation of corium interrupted by transverse venules, cells difficult to distinguish; with two basal veins; clavus with two veins........ .... *Porcorhinus*, p. 38.

26 (25). Scutellum reaching posterior end of body broad, sides parallel, apex broadly and obtusely rounded; head small, triangular, produced downward; base of scutellum with a truncated pyramidal protuberance at base; everywhere tuberculate; one-fourth of tegmina densely opaque, coriaceous veins barely distinguishable, lying flat on tergum beneath scutellum .... *Eufroggattia*, p.37.

TERENTIUS, Stal.

1866, Hemiptera Africana, iv. p. 87.

Prothorax moderately convex, unarmed above lateral angles; posterior process broad, then narrowed, acuminate, convex, a little narrower at base over scutellum which it touches, sinuate on each side, anteriorly furnished with an abbreviated carina; tectiform posteriorly.

Tegmina transparent, furnished between two interior longitudinal veins with a transverse venule near base, two discoidal cells, the interior petiolate, costal cell but little longer extended than radial, the former punctured; clavus not gradually narrowed to apex, furnished with two veins.

Wings with four apical cells.

Scutellum truncated at apex, on each angle a little tooth.

Tibiæ and tarsi simple, not dilated.

Type, *T. convexus*, Stal.

*T. CONVEXUS, Stal.

(Plate i., figs. 8 and 14.)

1869, Ofv. K. Vet.-Akad. Forh. p. 286.

Head densely punctured, front lightly inflexed, distinctly lobed at each side on lateral borders; ocelli above a line passing through centre of eyes.

Prothorax piceous, densely punctured, furnished with an almost obsolete median line, convex; posterior process broad and convex at base, much narrowed at middle, then very slender and acuminate, a longitudinal ruga below the middle, posteriorly elevated in a carina, apex distinctly curved downward, reaching tip of abdomen.

Tegmina vitreous, obscure at base, base and costa dilute piceous, radial and ulnar veins towards apex and veins including the discoidal cells blackish, the two discoidal cells of equal length.

Chest with sides dense silky gray, pubescent.

Legs with femora and base of tibiæ piceous, rest of tibiæ sordid yellow, tarsi piceous.

Long. 7; lat. 3 mm.

Type in Mus. Holm.

Food plant, *Hakea* sp.

Hab.—Rockhampton (Stal), Brisbane, Cairns, Q. (Tryon); Tweed River, N.S.W. (Froggatt); Williamstown, S.A. (Tepper).

As *T. convexus* and *Sertorius australis* differ only in absence and presence of lateral horns, I believe them to be two forms of one species.

DINGKANA, gen.nov.

Head triangular, punctured, pubescent, lobed on each side on lateral borders; ocelli above a line passing through centre of eyes to which they are a little nearer than to each other.

Prothorax rises convexly from base into the form of a dome, unarmed above lateral angles, coarsely punctured, median longitudinal carina anteriorly absent or obsolete; posteriorly the dorsum lightly descends into the posterior process which is very broad at base, gradually narrowed to middle, then attenuated to apex which is decurved reaching apex of abdomen; sides and dorsum of posterior process lightly sinuate.

Tegmina lanceolate, vinaceous, opaque at base, with three discoidal cells, the second and third placed between the two ulnar veins, the first between apex of radial and base of second apical cells; costa and radial vein piceous and punctured; destitute of a transverse venule between two ulnar veins, near the base.

Wings with four apical cells.

Legs simple.

Type, *D. borealis*, Godg.

Dingkana (dingkan—an insect, in the Koka-Yimidir language) differs from *Terentius* chiefly in the presence of three discoidal cells, the dorsum more elevated and dome-like, and the absence of a transverse venule between ulnar veins, near base; also in the position of the ocelli.

*D. BOREALIS, sp.nov.

(Plate i., fig. 21.)

Head piceous, finely punctured, front strongly inflexed, lobed on each side.

Prothorax convex, sordid black, finely punctured, narrowed behind lateral angles, extended in a long slender process, not sinuate below, sinuate above, reaching tip of abdomen, and nearly reaching apices of tegmina, the apex strongly and lengthily curved downward, the process touching the interior borders of tegmina the entire length.

Tegmina vitreous, vinaceous, punctured, ferruginous and opaque at base, radial and costal veins, and those including discoidal cells, ferruginous; second and third discoidal cells of equal length, the first much shorter.

Tibiæ yellowish brown.

Long. 5; lat. 2 mm.

Described from one female.

Type in Coll. F.W.G.

Hab.—Cairns, Q. (Tryon).

SEXTIUS, Stal.

Hemiptera Africana, iv. p. 88.

Prothorax elevated, perpendicular for a distance from base, with a percurrent median carina, armed on each side, above lateral angles, with an acute, triquetrous, diverging horn, or angulate; posterior process tectiform, a little concave below, the sides of the scutellum barely visible.

Tegmina with the apical portion of corium marked by the presence of many venules, which divide it into numerous apical cellules; costal cell punctured, opaque, extending beyond radial; exterior discoidal cell not petiolate; clavus punctured and opaque over basal half, not gradually narrowed towards apex, with two veins.

Wings with four apical cells.

Tibiæ dilated.

Type, *Centrotus virescens*, Fairm.

SYNOPSIS OF SPECIES.

1 (4). Prothorax armed with a horn above each lateral angle.
2 (3). Lateral horns directed outward, depressed towards apex, never turned upward; dorsum between lateral angles flat, never convex; corium destitute of a transverse venule between two ulnar veins............................ *depressus.*
3 (2). Lateral horns turned outward and upward; dorsum between lateral horns convex; corium furnished with a transverse venule between two ulnar veins near base. *virescens.*
4 (1). Prothorax unarmed or lightly tuberculate above lateral angles; a black spot on interior vein of clavus......... *bipunctatus.*

*S. VIRESCENS, Fairm.

(Plate i., fig. 2.)

1846, *Centrotus virescens*, Ann. Soc. Ent. Fr. (2), iv. p. 515.
1851, *Ceresa suffusa*, Walk., List Hom. Brit. Mus., p. 530.

Pale greenish or tawny, punctured, sometimes marked with piceous.

Prothorax with the lateral horns directed outward, slightly upward, usually much more elevated than the dorsum which is convex between the horns; posterior process long, slender, tectiform, extended nearly to apices of tegmina, tip decurved.

Tegmina pale tawny, a transverse venule between the two ulnar veins, near the base, the interior discoidal cell long and petiolate; basal half of costal, radial cells and clavus punctured and opaque.

Femora frequently black, tibiæ and tarsi tawny. Chest frequently piceous.

Long. 6 to 8; lat. (incl. lat. corn.) 3 to 4 mm.

Types in Coll. Fairmaire, and in British Museum.

Food plant, *Acacia decurrens.*

Hab.—New Holland (Fairmaire); Tarago, Clarence R., Gosford, Loftus, Wollongong, Bungendore, Homebush, N.S.W. (Lea); Maitland, Sydney, Penrith, Kempsey, Uralla, N.S.W. (Froggatt); Newcastle, N.S.W. (Hays): Brisbane (Tryon); Townsville, Q. (Dodd): Victoria (Stowell); Gisborne, Vic. (French): South Australia (Tepper): Pine R., Geraldton, West Australia (Lea).

This species is the most common membracid in Australia and the most widely distributed. Among those examined are the form *suffusa*, Walk., with the foreparts dusky, others with the head and chest black, and others variously marked with brown; the venation of the tegmina is very variable, there being a strong tendency to the presence of small venules.

Mr. Froggatt, in a most interesting article entitled "Insects of the Wattle Trees," which appeared in the 'Agricultural Gazette' for July, publishes the only account which has appeared on the habits of any of the Australian *Membracidæ*. He says, "This (*virescens*) is one of the commonest insects upon the young wattles, where they are much sought after by several species of ants that come to obtain the sugary secretions, popularly known as "honey dew," that they discharge from the abdominal glands. The female slits the bark with her ovipositor and lays the eggs in rows, the young larvæ and pupæ, as well as the perfect insects, being found clustering along the branchlets, but as soon as disturbed they crawl round the twig away from their enemies, and when touched they spring from the hind legs and jump for a considerable distance." The above graphic account is practically true of most of the *Membracidæ*, but some of the species of *Tragopa*, at least, live in the ground in the nests of ants.

*S. DEPRESSUS, sp.nov.

(Plate i., fig. 24.)

Green, tawny when dried.

This species, in a general way, is closely related to *virescens*; it differs in being smaller, lateral horns shorter and stronger, directed outward, not at all upward, the apical part depressed; the dorsum between the horns is flat, never convex; corium destitute of a transverse venule between two ulnar veins, near base.

Long. 5 to 7; lat. (incl. lat. corn.) 2 to 3 mm.

Described from nineteen males and females.

Types in Coll. F.W.G.

Food plant, *Acacia decurrens.*

Hab.—Pinjarrah, Bridgetown, West Australia (Lea): Brisbane, Q. (Tryon): Sydney, Rye Bay, Kempsey, Richmond R., Wollongong, Tweed R., Maitland, N.S.W. (Froggatt).

This species may be easily separated from *virescens* by the depressed appearance of the dorsum and horns, when viewed from the front, and absence of a transverse venule, near base of tegmina.

S. BIPUNCTATUS, Fabr.

1775, *Membracis 2-punctata,* Syst. Ent. p. 677.
1781, *Membracis 2-punctata,* Spec. Ins. ii., p. 318.
1787, *Membracis 2-punctata,* Mant. Ins. ii., p. 265.
1803, *Centrotus 2-punctatus,* Syst. Rhyng. ii., p. 19.
1869, *Sextius bipunctatus,* Stal, Hem. Fabr. ii., p. 52.

Yellowish gray.

Head very obtuse, short, front strongly inflexed.

Prothorax angulate only, or tuberculate, above lateral angles.

Tegmina tawny, a black spot on the middle of the interior vein of clavus, apex furnished with many cells.

I have not seen an example of this species, but doubt if it is distinct from *virescens*, which would then become a synonym.

The above description is but a translation of the one given by Stal. The measurement is not mentioned.

Type in Mus. Holm.

Hab.—New Holland (Fabricius).

ACANTHUCUS, Stal.

1866, Hemiptera Africana, iv. p. 87.

Prothorax elevated, rising vertically from the base, furnished with an acute triquetrous horn on each side, above lateral angles; posterior process slender, more or less sinuate, the median longitudinal carina between and behind lateral horns briefly foliaceous or elevated in a high tooth or horn.

Tegmina with the corium furnished with five oblong apical and two discoidal cells; costal cell extended beyond radial; the two interior longitudinal veins destitute of a transverse venule near base; clavus with two veins, gradually narrowed to apex.

Wings with four apical cells.

Scutellum with apex truncated, ending, on each side, in a little tooth.

Tibiæ and tarsi simple, not dilated.

Type, *Centrotus trispinifer*, Fairm.

SYNOPSIS OF SPECIES.

1 (6). Dorsum of posterior prothoracic process furnished with an acute elevation behind lateral horns.

2 (3). Posterior process far distant from the interior borders of closed tegmina, dorsum with a second elevation which is a high, triangular, acuminate horn; apical cells of corium crescent-shaped, base curved toward interior...... .... *rufiventris.*

3 (2). Posterior process touching interior borders of closed tegmina throughout, with a second elevation an obtuse angle; apical cells of corium straight.

4 (5). First dorsal elevation an acute angle..................... *trispinifer.*

5 (4). First dorsal elevation a slender spine.. .... *gracilispinus.*

6 (1). Posterior prothoracic process not horned behind the lateral horns, but the median carina is somewhat elevated in an obtuse angle, or lightly foliaceous.

7 (11). Dorsal carina behind lateral horns elevated in an obtuse angle.	
9 (10). Lateral horns short, turned outward and downward; size very small .... -	*Kershawi.*
10 (9). Lateral horns long, curved outward and upward; size large..	*conspurcatus.*
11 (7). Dorsal carina lightly foliaceous behind lateral horns, not angulate..............................	*bispinus.*

*A. RUFIVENTRIS, Walk.

(Plate i., fig. 13.)

1861, *Centrotus rufiventris*, Walk., List Hom. Brit. Mus. p. 616.

Ferruginous, with a golden pubescence.

Head piceous, triangular, minutely punctured, ocelli on a line passing through centre of eyes, and a little nearer to each other than to the eyes.

Prothorax roughly punctured, front lightly inclined backward; lateral horns stout, extending outward and a little upward, towards the apex curved slightly to the horizontal, on the superior surface an obsolete carina; dorsal horn long and acute; posterior process long, slender, deeply sulcate at the base, curved at the middle into a high, triangular, acute eminence, distant from the abdomen, thereafter sloping to the very much attenuated apex which just passes the tip of the abdomen, but does not reach the apices of the tegmina.

Tegmina pale tawny, punctured at the base and along the costa, a spot at the interior angle, and the veins surrounding the interior discoidal cell, ferruginous.

Abdomen varies in colour from red to ferruginous.

Legs ferruginous, tibiæ with a row of golden hairs along each angle; tips of tarsi piceous.

Long. ♀ 6; lat. 2; incl. lat. corn. 4 mm.

Type in British Museum.

Hab.—Moreton Bay, Q. (Walker): South Australia (Tepper).

*A. TRISPINIFER, Fairm.

(Plate i., fig. 7.)

1846, *Centrotus trispinifer*, Ann. Soc. Ent. Fr. (2), iv. p. 515, pl. viii., fig. 35.

Head fuscous, recurved, ocelli on a line with the centre of, and a little nearer to each other than to the eyes.

Prothorax ferruginous brown to piceous; armed over each lateral angle with a long, sharp horn, extending directly outward, apex turned a little downward and backward, superior surface with two small carinæ; dorsal horn triangular, stout and pointed; posterior process sulcate above the basal half, then forming an obtuse angle, the apical half turned downward, not reaching apex of abdomen.

Tegmina ferruginous, costa, base, and apical third somewhat opaque; corium with a light transverse band passing across the middle; exterior discoidal cell about one-half the size of interior.

Chest black, with a light ferruginous spot on each side.

Legs fuscous.

Long. ♂ 6, ♀ 7; lat. (incl. lat. corn.) ♂ 4, ♀ 4 mm.

Type in Coll. Westwood.

Hab.—New Holland (Fairmaire): Huon R., Hobart, Mount Wellington, Tasmania (Lea): Tweed R., N.S.W. (Lea); Gloucester, N.S.W. (Froggatt): South Australia (Tepper): Victoria (Kershaw).

*A. GRACILISPINUS, Stal.

1869, Ofv. K. Vet. Akad. Forh. p. 287.

Ferruginous, some silky white pubescence.

Prothorax punctured; lateral horns long, turned directly outward and obliquely upward, lightly decurved toward apex; the dorsal horn is erect, slender, rather long; posterior process distinctly curved behind the middle, while in front it is a little elevated.

Tegmina grayish hyaline, bases and towards apices ferruginous, base and costa punctured.

Scutellum and chest densely silky.

Long. ♀ 5½; lat. 2½ mm.

Type in Mus. Holm.

Hab.—Northern Australia (Stal): Bruni Is., Tasmania (Lea): Victoria (French): South Australia (Tepper): Bunbury, West Australia (Lea): Clarence R., Tweed R., N.S.W. (Lea).

This species is closely related to *A. trispinifer;* it differs in the longer lateral horns, which ascend obliquely, while the dorsal horn is longer, more slender and acute.

*A. CONSPURCATUS, Stal.

1869, Ofv. K. Vet. Akad. Forh. p. 288.

Ferruginous, punctured.

Prothoracic lateral horns medium, turned forward and distinctly upward, very slightly curved; median longitudinal carina elevated, behind the lateral horns, in an obtuse angle; posterior process lightly curved.

Tegmina sordid hyaline, base and costa ferruginous and punctured, with an obsolete apical ferruginous spot; with two discoidal cells.

Long. ♀ 4⅔; lat. 2 mm.

Type in Mus. Holm.

Hab.—West Australia (Stal): Tweed R., Blue Mts., N.S.W. (Froggatt): Mt. Wellington, Huon R., Tasmania (Lea): South Australia (Tepper): Victoria (French).

Closely allied to *A. trispinifer*, but differs in the lateral horns being turned distinctly upward and the dorsum destitute of an acute median horn.

*A. BISPINUS, Stal.

1869, Ofv. K. Vet. Akad. Forh. p. 288.

Ferruginous black, punctured.

Prothoracic lateral horn short, directed outward, destitute of a horn or angle behind these horns; posterior process lightly curved, and lightly foliaceous at base.

Tegmina subvinaceous hyaline, base and costa ferruginous and punctured; base of third apical cell curved toward interior. Sides of chest and scutellum densely silky gray, pubescent.

Long. ♂ 4½, ♀ 5; lat. 2 mm.

Type in Mus. Holm.

Food plant, *Acacia pycnantha.*

Hab.—Australia (Stal): Homebush, Tweed R., Sydney, N.S.W. (Lea); Clermont, Tweed R., Maitland, Mittagong, Richmond R., N.S.W. (Froggatt): Swan R., Geraldton, Pinjarrah, West Australia (Lea): Largs Bay, N. Mecklenburg, South Australia (Tepper): Victoria (French): Tasmania (Simson).

Resembles the preceding, differing from it in the lateral horns being turned outward, and the median carina not elevated in an angle or horn, but slightly foliaceous at middle. The male is smaller, its lateral horns very diminutive.

*A. KERSHAWI, sp.nov.

Head black, triangular, apex acute, strongly curved backward. Eyes prominent; ocelli above a line passing through centre of eyes, near base, nearer to eyes than to each other.

Prothorax inclined backward from base, piceous brown, covered with yellow hairs; lateral horns short, turned directly outward, horizontal, slender, very acute; posterior process obtusely angled at base, thereafter slender, strongly sinuous to decurved acuminate apex, which does not reach the tips of tegmina.

Tegmina with the costa and clavus entirely opaque and punctured, two discoidal cells, the second nearly circular, almost reaching exterior border of corium; veins brown, covered with yellow hairs; third apical cell crescentiform.

Body, femora and tarsi black.

Long. ♂ 3½, ♀ 4 mm.; lat. ♂ 1, ♀ 1½ mm.

Described from one male and two females.

Types in Coll. F.W.G.

Hab.—Thornleigh, Blue Mts., N.S.W. (Froggatt).

Dedicated to Mr. J. A. Kershaw, of the Melbourne Museum, who supplied me with a number of interesting Australian forms.

SERTORIUS, Stal.

1866, Hemiptera Africana, iv. p. 88.

Prothorax rising vertically from the base, furnished with an acute or equally broad horn, on each side, above lateral angles, distant between bases; posterior process touching scutellum, not distant; the median carina not elevated, but percurrent.

Tegmina with five oblong apical and two discoidal cells; the two ulnar veins of the corium joined near base by a transverse venule; exterior discoidal cell not petiolate; costal cell punctured and opaque, extended beyond radial; clavus with two veins, gradually narrowed to apex.

Wings with four apical cells.

Scutellum transverse or almost equally long and wide, apex truncate, ending on each side, in a little tooth.

Tibiæ and tarsi simple, not dilated.

Type, *Centrotus australis*, Fairm.

SYNOPSIS OF SPECIES.

1 (2). Lateral horns very short and small, third apical cell of tegmina long, straight; females with, and males destitute of, transverse venule between two ulnar veins, near base............ *australis.*
2 (1). Lateral horns large and strong.
3 (10). Lateral horns conical, gradually narrowed towards apices.
4 (9). Third apical cell of corium long, narrow.
5 (6). Third apical cell of corium furnished with transverse venules............ *areolatus.*
6 (5). Third apical cell of corium destitute of transverse venules.
7 (8). Lateral horns turned outward and backward, short; tegmina more or less piceous............ *brevicornis.*
8 (7). Lateral horns turned outward and forward; tegmina transparent smoky yellow............ *Tepperi.*

9 (4). Third apical cell of corium not narrow; apex of first apical cell of corium not extended beyond base of second apical cell; tegmina colourless, veins piceous, cells short.. *curvicaudus.*

10 (3). Lateral horns with sides parallel, not, or very slightly, narrowed towards apices which are subtruncated, anterior angle rounded, posterior acute.

11 (12). Lateral horns turned directly outward, lightly upward, broad at bases, widely separated, very strong........ *giganticus.*

12 (11). Lateral horns long, slender, very lightly curved, turned outward, strongly upward, narrow at base............ *acanthaspis.*

*S. AUSTRALIS, Fairm.

1846, *Centrotus australis*, Ann. Soc. Ent. Fr. (2), iv. p. 518.

1858, *Centrotus obstans*, Walk., List Hom. Brit. Mus. Suppl. p. 162.

1858, *Centrotus binotatus*, Walk., Ins. Saund. Hom. p. 81.

Head piceous, broad, short, a small tooth on each side of the apex which is curved backward.

Eyes large, prominent beyond sides of the prothorax; ocelli above line passing through centre of the eyes, to which they approach more nearly than to each other; base lightly curved.

Prothorax piceous, convex. coarsely punctured, with a median longitudinal carina; lateral horns very small, short, conical, extended directly outward; posterior process broad at base, gradually narrowed to the middle, thereafter slender, acuminate, decurved, reaching apices of tegmina; at the base it is notched showing the white tomentum on the scutellum.

Tegmina vitreous, tinged with yellow, the base, a spot at the interior angle, and veins ferruginous; a transverse venule between two ulnar veins near base in the female, absent in the male; clavus vitreous.

Legs ferruginous; tarsi piceous.

Long. ♀ 7, ♂ 6; lat. ♀ 3, ♂ 2½ mm.; incl. lat. corn. ♀ 4, ♂ 3 mm.

Types in Coll. Fairmaire, British Museum and Coll. W. W. Saunders.

Hab.—New Holland (Fairmaire): Gosford, N.S.W. (Lea): Victoria (Kershaw): Tasmania (Simson): Williamstown, South Australia (Tepper).

My opinion is that *Terentius convexus*, Stal, is a horned form of this species.

*S. ACANTHASPIS, Fairm.

1846, *Centrotus acanthaspis*, Ann. Soc. Ent. Fr. (2), iv. p. 515.
1851, *Centrotus decisus*, Walk., List Hom. Brit. Mus. p. 621.

Head spindle-shaped, apex not produced, brown, punctured, lateral borders a trifle foliaceous; ocelli on a line with the centre of and approaching to the eyes; with a median carina; base lightly curved.

Prothorax punctured, brown, with scattered yellow hairs, and a smooth black scar on each side in front; lateral horns turned outward, a little upward and forward, strongly triquetrous, bases far apart, apices obtuse; posterior process thickened at base, gradually acuminate to the decurved apex which reaches the tips of the tegmina, passing apex of abdomen, the inferior edge sinuate. There is some yellow pubescence on the sides of the chest and on the scutellum.

Tegmina transparent, a little smoky yellow, bases of clavus and radial cell, and nearly all of the costal cell, with the veins, ferruginous.

Legs ferruginous.

Long. 9; lat. 3 mm., incl. lat. corn. 5 mm.

Types in the Museum of the Entomological Society of France and the British Museum.

Hab.—Port Jackson (Fairmaire); Tweed R., Tamworth, Wellington, N.S.W. (Froggatt): Highfields, Q. (Tryon): Murray R., South Australia (Tepper).

*S. GIGANTICUS, sp.nov.

(Plate i., fig 1.)

Head black, broad, punctured and impressed, apex produced, lateral borders with a denticle near base; ocelli equidistant from each other and the eyes, and on a line through the centre of the eyes; base lightly curved.

Prothorax black, densely and rudely punctured, furnished with a median carina, and armed above each lateral angle with a strong, triquetrous horn, which is turned outward and a little upward, not at all forward, broad, compressed, and flattened at apex, which is obtusely rounded, the posterior angle acuminate; the posterior surface is broadest, on the inner surface several carinæ; dorsum between the lateral horns broad, flat, increasing in altitude backward; posterior process starts from the highest point, is tectiform, and broad for some distance from the base, thereafter gradually acuminate to the apex which just passes the tip of the abdomen; laterally there are a few carinæ.

Tegmina ferruginous, opaque, basal portion and nearly all of costal cell punctured, a white spot at the interior angle.

Legs piceous, tibiæ triquetrous.

Long. ♀ 12; lat. 4 mm., incl. lat. corn. 6 mm.

Described from two females.

Types in Coll. F.W.G.

Hab.—South Australia (Tepper).

This is the largest Membracid yet found in Australia.

*S. BREVICORNIS, sp.nov.

Head piceous, covered with yellow hairs, with an abbreviated median carina in the centre between the ocelli, two small tubercles below and forming a square with the ocelli, lateral borders with a denticle near base; ocelli on a line passing through the centre of the eyes and equidistant from them and from each other; base lightly curved.

Prothorax piceous brown, the dorsum convex, blackish along the middle, and furnished with a strong, black median longitudinal carina; on each side of the dorsum, above lateral angles, is a short, stout, triquetrous, auricular horn turned upward, which is blackish on the convex superior surface towards the very obtuse tip, which ends in a blunt point, pointing outward, and a trifle backward; the horn is elevated but little above the middle of the dorsum; the posterior process is triquetrous, tectiform, lightly gibbous at the base, broad for a distance, thereafter gradually acuminate to the apex which reaches the end of the abdomen.

Tegmina broad, basal third black, punctured and opaque, the remainder transparent smoky, veins, and a large spot on the disk, piceous.

Sides of the chest and scutellum yellow pubescent.

Legs strong, piceous; tibiæ triquetrous, slightly flattened, a central carina from base to apex.

Long. ♀ 6; lat. 3 mm., incl. lat. corn. 4 mm.

Described from two females.

Types in Coll. F.W.G.

Hab.—South Australia (Tepper): Mt. Barker, West Australia (Lea).

The ear-shaped lateral horns will easily distinguish this species.

*S. TEPPERI, sp.nov.

Head black, punctured, triangular, apex produced strongly backward; ocelli on a line with superior border of eyes and equidistant from them and from each other.

Prothorax piceous brown, base black, punctured, furnished with a median percurrent carina, and armed on each side, above lateral angles, with a short, stout, triquetrous, acuminate horn turned upward, very lightly outward, and strongly forward, the upper surface marked with two or three small carinæ near the front edge, the posterior edge of each horn continued for some distance on the posterior process as a carina, parallel to the median carina; posterior process very broad and convex at base, gradually narrowed to the middle, thereafter slender and acuminate, reaching tips of tegmina.

Tegmina smoky yellow, basal fourth piceous, punctured and opaque, the remainder transparent, veins ferruginous and thick.

Body below black; tibiæ and tarsi lighter.

Long. ♀ 6; lat. 2 mm.; incl. lat. corn. 3 mm.

Described from two females.

Types in Coll. F.W.G.

Hab.—Bunbury, West Australia (Lea).

Dedicated to Mr. J. G. O. Tepper, Entomologist to the South Australian Museum, who has been most liberal in his donation of material.

S. AREOLATUS, sp.nov.

(Plate i., fig. 3.)

A long, slender, short-horned, ferruginous species.

Head punctured, covered with yellow hairs, the base nearly straight, apex recurved; ocelli above a line passing through the centre of the eyes from which they are about equidistant and from each other.

Prothorax punctured, covered with yellow hairs, with a long shining scar over each eye; furnished with a percurrent median carina; it is armed on each side, above lateral angles, with a triquetous, conical, almost erect horn which is turned strongly upward, a little inclined outward, the obtusely pointed tip turned directly outward, with three small carinæ on the superior surface; posterior process tectiform, straight, sinuate along inferior border, narrow at base, long and slender, gradually acuminate to apex which curves strongly downward, reaching tips of tegmina.

Tegmina long, narrow, lanceolate, smoky, vitreous, base and veins ferruginous, a piceous spot on interior angle, and veins surrounding third apical cell, of the same colour; corium with long, narrow, discoidal cells, of equal size, the third apical cell, very long and narrow, crossed by several transverse venules.

Sides of chest and scutellum covered with yellow down. Femora black, tibiæ and tarsi ferruginous.

Long. 7; lat. 2 mm.; incl. lat. corn. 4 mm.

Described from five males and eight females.

Types in Coll. F.W.G.

Hab.—Victoria (Kershaw): South Australia (Tepper): Braidwood and Queanbeyan, N.S.W. (Lea).

This species may easily be separated from its congeners by the long, narrow, slender form, and areolated third apical cell.

*S. CURVICAUDUS, sp.nov.

Head triangular, base nearly straight, lateral borders denticulate; ocelli on a line passing through centre of eyes, and equidistant from each other and the eyes.

Prothorax piceous, with a median percurrent carina, armed on each side with a rather long, very flat horn turned almost directly outward, very slightly upward, apex curved a little backward, and but little elevated above dorsum; posterior process very broad from base to middle, then slender and gradually acuminate to the apex, strongly decurved from base to the apex which reaches tips of tegmina.

Tegmina with very little of base punctured, vitreous, and transparent, veins piceous, corium with first discoidal cell about one-half the size of the second, the second apical cell very small.

Long. 7; lat. 2 mm.; incl. lat. corn. 5 mm.

Described from two males.

Types in Coll. F.W.G.

Hab.—Tweed River, N.S.W. (Froggatt).

A small piceous species with the posterior process strongly curved downward from base to apex.

EUFRENCHIA, gen.nov.

Head nearly triangular, lateral border denticulate, convex in front, base nearly straight; eyes prominent outward.

Prothorax rudely punctured or reticulate, rises vertically from base, armed on each side with a long, strong, vertical, flattened horn, with sides parallel, superior part curved outward, falciform, apex obtuse, with two little teeth, between which is a shallow sulcus; posterior process long, slender, apex lightly decurved slightly passing apices of tegmina; lateral horns near at bases, between which median carina is obsolete.

Tegmina with cells of corium narrow, three discoidal cells, the first placed between the radial and first ulnar veins in front of second apical cell, second and third between the first and second ulnar veins behind the third and fourth apical cells; furnished with a transverse venule between the two ulnar veins, near base.

Wings with four apical cells.

Tibiæ flattened and lightly dilated.

Type, *Centrotus falcatus*, Walk.

This genus differs from the last section of *Sertorius* in having three discoidal cells.

Dedicated to Mr. Charles French, Government Entomologist of Victoria, for his uniform kindness and courtesy.

SYNOPSIS OF SPECIES.

1 (2). *Falciform portion of lateral horns brief, base of posterior process broad*.. *Leæ.*

2 (1). Falciform portion of lateral horns very long, base of posterior process proportionately slender....................... *falcata.*

*E. FALCATA, Walk.

1851, *Centrotus falcatus*, List Hom. Brit. Mus. p. 62.
1869, *S. curvicornis*, Stal, Ofv. K. Vet. Ak. Forh. p. 287.

Head piceous, punctulate; ocelli above a line passing through centre of eyes, a little nearer to the eye than to each other.

Prothorax fusco-ferruginous, densely and strongly punctured, almost reticulate with a median longitudinal carina which is interrupted between lateral horns, seen from front, narrowed upward, lateral horns contiguous at base, erect to middle, then strongly curved outward and downward, broad, long, sides parallel, apices truncated, anterior apical angle rounded, posterior angle in a prominent tooth; posterior process convex, rather slender, curved downward from middle, apex black, reaching tips of tegmina.

Tegmina pale subfuscous hyaline, veins fuscous, punctured on each side, the basal and costal cell subferruginous, punctured beyond middle. Chest black, a spot on chest and scutellum yellowish-gray pubescent.

Long. ♂ 5, ♀ 6; lat. ♂ 2, ♀ 2½; exp. corn. ♂ 6, ♀ 7 mm.

Female differs little from male.

Types in British Museum and Mus. Holm.

Hab.—Adelaide, South Australia (Stal): Van Dieman's Land (Walker).

*E. LEÆ, sp.nov

(Plate i., fig. 5.)

Head black, punctured; ocelli as in *falcatus*.

Prothorax dark ferruginous, punctured; lateral horns, not contiguous at bases, extend upward and strongly forward, long, sides parallel, a small apical portion outward, apical angles as in *falcatus;* posterior process tectiform, not convex, strong and broad at base, gradually narrowed to apex which reaches apices of tegmina.

Tegmina ferruginous, opaque, veins darker and punctured along their sides, one-third of clavus and radial cell, and all of costa, densely opaque and punctured, and opaque spot on apex of first apical cell.

Long. ♀ 6; lat. 1¾; exp. lat. corn. 3 to 3½ mm.

Described from seven females.

Types in Coll. F.W.G.

Hab.—West Australia (Lea).

Dedicated to Mr. A. M. Lea, Government Entomologist of Tasmania, who kindly presented this and other interesting forms.

CENTROTYPUS, Stal.

1866, Hemiptera Africana, iv. p. 88.

Front a little prominent downward; ocelli lightly prominent; destitute of lobes on lateral borders.

Prothorax horned above lateral angles, the horns triquetrous, conical; the posterior process acuminate, almost covering scutellum; median carina a smooth line anteriorly.

Tegmina with five apical and two discoidal cells, the interior petiolate, the two ulnar veins not joined, near the base, with a transverse venule; costal and radial cells almost equally long.

Wings with four apical cells.

Tibiæ simple.

Type, *Centrotus flexuosus*, Fabr.

This genus differs from *Sertorius* only in the absence of the transverse venule between the two ulnar veins, a very weak character.

SYNOPSIS OF SPECIES.

1 (2). Third apical cell straight, first discoidal cell long, narrow, two-thirds length of second; lateral horns turned outward, downward and backward; size large. ...... *occidentalis.*

2 (1). Third apical cell crescentiform, base curved toward interior angle; first discoidal cell triangular, small; lateral horns very short and minute; size very small. *minutus.*

*C. OCCIDENTALIS, sp.nov.

Ferruginous, the head, base of prothorax excepting the edge, tips of lateral horns, chest, abdomen, femora excepting the tips, a spot on the tibiæ, and tips of tarsi, black.

Head as long as broad, base strongly curved, the apex produced downward, toothed on lateral borders, punctured; ocelli white, placed above a line passing centre of eyes to which they approach nearer than to each other.

Prothorax punctured, furnished with a percurrent median carina; dorsum convex, armed on each side, above lateral angles, with a short, flat, conical horn, compressed infero-superiorly, turned directly outward, apex obtuse, inclined a little downward and backward, the upper surface with the dorsum, convex; posterior process stout at the base, not tectiform, sinuous along inferior border, and gradually acuminate to the apex which reaches the tips of the tegmina.

Tegmina vitreous, clear, veins ferruginous, punctured at base, a blackish cloud near base of clavus; first discoidal cell two-thirds length of second, equal to and lying alongside of first apical cell.

Long. 6½; lat. 2½; incl. lat. corn. 4 mm.

♀ Differs from the male in being tawny yellow, and ferruginous where the male is marked with black, and the larger size.

Long. 9; lat. 3½; incl. lat. corn. 5 mm

Described from two males and one female.

Types in Coll. F.W.G.

Hab.—Swan River, West Australia (Lea).

*C. MINUTUS, sp.nov.

Head black, triangular, deorsum, with scattered yellow hairs; ocelli above a line passing through centre of eyes to which they are nearer than to each other, base barely curved.

Prothorax black at base, and apex, otherwise dark brown, convex, armed on each side above lateral angles with a very minute pointed horn extended directly outward; the dorsum most elevated at base of posterior process which is distinctly sinuous, tectiform, acuminate, apex reaching end of abdomen, but shorter than apices of tegmina.

Tegmina broad, short, ferruginous, and punctured at base, nearly all of costal and basal third of radial cells punctured and opaque; corium with the first discoidal cell triangular, half size of second, the second long narrow, directed diagonally to apical veins; third apical cell with base curved toward interior angle; veins milky white; first apical cell minute.

Body below black. Tibiæ and tarsi ferruginous.

Long. 3; lat. 1 mm.; but little broader between apices of lateral horns.

The female differs from the male in the lateral horns which are little more than minute tubercles, and the broader basal cells.

Described from three males and one female.

Types in Coll. F.W.G.

Hab.—South Australia (Tepper): Mosman's Bay, N.S.W. (Froggatt); Clarence River, Tamworth, N.S.W. (Lea).

This minute species is the smallest yet found in Australia, and the smallest of the genus known.

LUBRA, gen.nov.

Head triangular, lateral borders sinuous.

Prothorax rising vertically from the base, the dorsum appears to divide into two long anteriorly inclined horns which are enlarged towards the apex rounded on the top (not truncated), the inner angles produced in triangular acuminate spines, the surface reticulated; the posterior process is much shorter than the tegmina and sinuate.

Tegmina with two discoidal cells, the second petiolate, furnished with a transverse venule between two ulnar veins, near base.

Wings with four apical cells.

Legs very slightly flattened.

I have chosen for the name of this genus the aboriginal word meaning "wife." It is closely related to *Daunus*.

Synopsis of Species.

1 (2). Apices of dorsal horns furnished with a slender spine on the outer side, converging to form an arch by the meeting of the acuminate interior angles of the apices *regalis*.

2 (1). Apices of dorsal horns widely separated; interior angle of each apex not acuminate, but gibbous, with a slender spine on exterior angle.......... .... *spinicornis*.

*L. SPINICORNIS, Walk.

1862, *Oxyrhachis spinicornis*, Journ. Ent. i. p. 316.

Head piceous, strongly punctured; ocelli on a line passing through centre of eyes, and a little nearer to the eyes than to each other.

Prothorax dilute piceous, rising vertically from the base with the lateral horns thick, very long, erect, slightly inclined forward, curved, thickly and rudely reticulated; the apex is much thickened, and armed with a sharp spine on the outer side, extending directly outward; posterior process very long and slender, apex decurved, reaching apices of the tegmina.

Tegmina broad, vinaceous, veins darker, base and nearly all of costa ferruginous, opaque and punctured, the third apical cell normal, basal half of clavus punctured and opaque.

Chest with yellow pubescence.

Legs ferruginous.

Long. ♀ 8; lat. 3 mm.

Type in the British Museum.

Hab.—Moreton Bay, Q. (Walker): Tweed River, N.S.W. (Froggatt); Clarence River, N.S.W. (Lea).

*L. REGALIS, sp.nov.

(Plate i., figs. 4 and 9).

Head piceous, triangular, with two minute tubercles on each side on the lateral borders; ocelli near the base, above a line passing through the centre of eyes, equidistant from each other and the eyes.

Prothorax dark ferruginous, rising vertically from the base, laterally compressed, the dorsum widened on each side into a long laterally compressed horn, which is much thickened and reticulated towards the apex and much inclined forward, the apex curved inward ending in a triangular point which meets with its fellow forming the half of a circle, bearing a short, stout, sharp spine on the exterior surface; the posterior process is very slender, sinuous, much shorter than the tegmina, the apex acuminate

Tegmina clear, vitreous, with the entire basal fourth ferruginous, punctured and opaque, the veins and a large spot of the same colour on the apices; clavus gradually acuminate, vitreous, ferruginous at the base, with two veins.

Legs light ferruginous, tips of tarsi piceous.

Described from one example, the body of which is wanting.

Type in Coll. F.W.G.

Hab.—Brisbane, Q. (Tryon).

DAUNUS, Stal.

1866, Hemiptera Africana, iv. p. 87.

Prothorax elevated, furnished with a median carina, armed on each side above lateral angles with a broad horn, triquetrous at the base, compressed upward from front and behind; apex broadened, truncated, sometimes furnished with a very short spine; posterior process acuminate, rarely reaching apices of tegmina.

Tegmina destitute of transverse venule between two ulnar veins, near base, with five oblong apical and two discoidal cells, the interior petiolate; costal cell extended beyond radial, both punctured and opaque; exterior discoidal cell not petiolate; clavus punctured and opaque at base, with two veins, gradually narrowed to apex.

Wings with four apical cells.

Scutellum transverse, almost equally long and wide, apex truncated, ending on each side in a little tooth.

Tibiæ and tarsi simple (in one species dilated).

Type, *Centrotus Tasmaniæ*, Fairm.

Synopsis of Species.

1 (4). Lateral horns nearly erect; apex of posterior process not passing tips of tegmina; head triangular; tibiæ not dilated.

2 (3). Corium furnished with a longitudinal, ferruginous stripe along middle from base to apex; third apical cell normal........ .... *vitta.*

3 (2). Corium smoky yellow, destitute of ferruginous stripe; third apical cell furnished with transverse venules..... *Tasmaniæ.*

4 (1). Lateral horns inclined forward; apex of posterior process far surpassing tips of tegmina; head nearly square, lateral borders foliaceous; front tibiæ dilated......... ... *gracilis.*

*D. TASMANIÆ, Fairm.

(Plate i., figs. 6 and 20).

1846, *Centrotus Tasmaniæ*, Ann. Soc. Ent. Fr. (2), iv. p. 513, pl. 3, fig. 15.

1851, *Centrotus contractus*, Walk., List Hom. Brit. Mus. p. 622.

1858, *Centrotus truncaticornis*, Walk., Ins. Saunds. Hom. p. 81.

Head black, triangular, apex a little recurved; ocelli on a line with centre of eyes, and a little further from each other than from the eyes.

Prothorax dark ferruginous brown, punctured, rising vertically from base, lateral horns strong, upright, a little diverging, somewhat constricted along middle, dilated at the apex, which is truncated, the inferior angle being acute; the inner and anterior surfaces with little carinæ; lateral angles prominent; posterior process long, slender, straight, the apex a little decurved, reaching the tip of the abdomen, but much shorter than the tegmina.

Tegmina broad, ferruginous, costa and base punctured and opaque, the third apical cell of corium with several transverse venules; clavus punctured at base, gradually narrowed to apex, with two veins.

Chest and abdomen piceous, covered with dense white pubescence.

Legs piceous.

Long. ♂ 7, ♀ 9; lat. ♂ 2, ♀ 3 mm.

Types in Collections of Serville, Signoret and Lefèbre, British Museum, and W. W. Saunders.

Hab.—New Holland (Fairmaire): Hobart, Tasmania (Lea): Gisborne (French); Port Phillip, Victoria (Walker): Brisbane, Q. (Tryon).

This is the most common species in Tasmania.

*D. VITTA, Walk.

(Plate i., fig. 25).

1851, *Centrotus vitta*, Walk., List Hom. Brit. Mus. p. 626.
1858, *Oxyrhachis contorta*, Walk., Ins. Saunds. Hom. p. 66.

Head triangular, ferruginous, punctured, ocelli on a line with the centre of, and much nearer to each other than to the eyes.

Prothorax ferruginous, lightly pubescent, vertical in front; the lateral horns almost erect, triquetrous, much more widely separated at the apices than at bases; two carinæ on the inner surface; apices much broadened, outer angle acutely produced, inner angle rounded; posterior process long, slender, sinuous at the middle, apex reaching almost to the tips of tegmina.

Tegmina long, clear, lanceolate, base ferruginous, and punctured; veins, and a broad longitudinal stripe along the middle of corium, ferruginous, the discoidal cells of equal size; clavus gradually acuminate, the base, a large spot at the middle and one at the apex, ferruginous.

Legs ferruginous, tips of tarsi piceous.

Long. ♂ 6, ♀ 7; lat. ♂ 2, ♀ 2½ mm.

Food plant, *Acacia decurrens*.

Hab.—Tasmania (Walker): Camden Haven, Penrith, Sydney, N.S.W. (Froggatt); Queanbeyan, Bungendore, N.S.W. (Lea): South Australia (Tepper).

This species is easily recognised by the slender form, and the ferruginous stripe on the tegmina.

*D. GRACILIS, sp.nov.

Head piceous, nearly square, the apical portion nearly as broad as the base, sides foliaceous; ocelli on a line with the centre of the eyes, nearer to the eyes than to each other.

Prothorax piceous brown, punctured with black, with a distinct median carina; it rises vertically from the base, over each lateral angle furnished with a strong, quadrangular, black, nearly erect horn, which is inclined lightly outward, strongly forward, the sides parallel nearly to the apex, which is broadened, truncate, the inner angle slightly rounded, the outer angle produced in a blunt point; the truncated surface is marked with four reddish carinæ; the posterior process is very slender, lightly sinuous, acuminate, exceptionally long, reaching beyond the tips of the tegmina, the apical fifth bent a little upward.

Tegmina long, very narrow, vitreous, with piceous veins; the interior discoidal cell longer than exterior, the last four apical cells with their bases in a line, the first placed nearly at the middle of the exterior border; clavus vitreous, with two piceous veins.

Tibiæ reddish, all dilated; tarsi tawny.

Long. ♀ 7½; lat. 1½ mm.; lat. incl. lat. corn. 3½ mm.

Described from one female.

Type in Coll. F.W.G.

Hab.—West Australia (Lea).

The species may be easily recognised by the long, very slender form, the vitreous tegmina, and the dilated tibiæ. It is closely related to the subfamily *Membracinæ*, but the exposed sides of the scutellum place it outside of that group.

EUTRYONIA, gen.nov.

Head triangular, recurved, ocelli above a line passing through the centre of eyes, equidistant from each other and the eyes.

Prothorax elevated into a convex, dome-shaped form, above which rises a very high, strong, erect process, laterally compressed, dilated at the apex in a very large transverse, cylindrical process which is deeply sulcate in the middle, anterio-posteriorly, and armed on each side with a directly diverging long, very acute spine; at the middle of this process, posteriorly, is a large tuberosity, below which is a large gibbosity; some distance behind the lateral angles the prothorax is suddenly narrowed, and produced into a long, slender, sinuous, acuminate process, the apical half distant from the abdomen, the apex reaching tips of tegmina, curving downwards.

Tegmina coriaceous, opaque, ferruginous; costa punctured; corium with two discoidal cells, the exterior triangular, the interior oblong, petiolate, and about twice larger, destitute of a transverse venule between two ulnar veins, near base; clavus gradually acuminate, with two veins.

Wings vitreous, with four apical cells.

Tibiæ with the anterior and middle pairs dilated.

Type, *Centrotus monstrifer*, Walk.

Dedicated to Mr. Henry Tryon, the Queensland Government Entomologist, who kindly placed this and other interesting material in my hands for study.

*E. MONSTRIFERA, Walk.

(Plate i., figs. 10, 11, 22 and 26).

1858, *Centrotus monstrifer*, Walk., Ins. Saunds. Hom. p. 80.
1862, *Oxyrhachis ponderifer*, Walk., Jour. Ent. i. p. 316.

Piceous brown, pubescent, apex of dorsal horn marked with luteous, also the lateral spines, the posterior process with a broad band of the same colour.

Tegmina ferruginous, coriaceous and opaque, with a Y-shaped white band across the middle, another band across the discoidal portion; tips of tarsi luteous.

Abdominal joints luteous.

♀. Long. 6; lat. 2 mm.

Types in the Collection of W. W. Saunders, and in the British Museum.

Hab.—Hunter R., N.S.W., Moreton Bay (Walker): Rockhampton, Q. (Tryon): Tweed R., N.S.W. (Froggatt).

Entryonia is closely related to *Sphongophorus* of America, but the exposed sides of the scutellum place it in the subfamily *Centrotinæ*.

HYPSOPHORA, Stal (Subfamily *Membracinæ*).

1869, Ofv. K. Vet. Ak. Forh. p. 277.

Head with lateral margins straight towards the eyes, foliaceous.

Prothorax on the dorsum, in front, armed with an elevated process, erect or inclined; posterior process covering scutellum, on each side behind the middle carinated, or with a large tubercle, which is prominent beyond the sides of the process.

Tegmina more or less coriaceous and opaque.

Tibiæ with the anterior pair dilated, foliaceous; tarsi simple.

Type, *Pterygia pileata*, Fairm.

H. CASSIS, Buck.

1901, Monog. Ent. p. 60, pl. ix., ♂ fig. 2; ♀ fig. 3

General colour, dark brown (♂), ochreous yellow (♀).

Head dilated, foliaceous.

Prothorax on the dorsum furnished with a pointed protuberance between the shoulders resembling a helmet, produced posteriorly at the base in a large tuberosity, and at the apex similarly produced; furnished with a posterior process.

Tibiæ subspatulate, foliaceous.

Long. ♂ 6, ♀ 7; lat. 5 mm.

Hab.—North Australia (Wollaston).

This crude description is taken from Buckton's work, and I follow him in placing the species in the above genus, but with hesitation, as I have not seen an example. My opinion is that it should be placed elsewhere.

PHILYA, Walk. (Subfamily *Membracinæ*).

1858, List Hom. Brit. Mus. Suppl. p. 126.
1858, (?) *Azinia*, Walk., Ins. Saunds. Hom. p. 63.
1869, *Aechmophora*, Stal, Kong. Sv. Vet. Ak. Handl. viii., p. 39.

Head with lateral margins straight towards the eyes, foliaceous.

Prothorax low, not compresso-elevated, middle of dorsum acutely carinated, furnished with a long, thick subcompressed, porrect process, the apex ascending; posterior process long, reaching nearly to the apex of tegmina, somewhat narrowed towards apex, subcoarctate in front of middle.

Tegmina coriaceous, opaque, with venation indistinct.

Tibiæ dilated, foliaceous; tarsi simple.

Types, *P. bicolor* (in British Museum), *A. elephas* (Mus. Holm. et Stal), *A. pallidipennis* (Coll. W. W. Saunders).

(?) P. PARVULA, Buck.

1901, Monog. Ent. p. 57, pl. viii., fig. 4.

Eyes prominent, abnormally placed on the side, and high on the head. The colour is dusky ochreous-brown, the anterior horn developed into a recurved process, with lateral carinæ, apex truncated.

Legs lightly flattened.

Long. 5 mm.; lat. 1 mm.

Hab.—West Australia (Haswell).

Buckton places this species in the above genus with hesitation, stating that it closely resembles the *Fulgoridæ*. I doubt if he has correctly located it.

EUFROGGATTIA, gen.nov.

Head small, triangular, base semicircular, eyes medium; ocelli situated high above the eyes near base of head, a little nearer to the eyes than to each other; apex broad, notched at middle.

Prothorax very broad, furnished with a median carina; rising perpendicularly from the head, above each lateral angle is a broad, flattened, strong, horn extended outward and a little forward, with sides parallel, apex truncated, at the superior angle bearing a short, slender spine at the side of which is a sulcus; posteriorly terminating, behind lateral horns, the posterior border lightly curved backward, destitute of a posterior process; scutellum very broad and long, resembling a shield, the sides parallel nearly to the apex which is very obtusely rounded and reaches end of abdomen; at the base of the scutellum is a dorsal protuberance of about the size of the lateral horns, pyramidal, truncated at the apex, the median carina continued on scutellum but terminating some distance in front of apex, much more distinct in female. The entire surface is rugose, two tubercles on each side of the median carina in front, three irregular rows of tubercles along the dorsum on each side, and a row along the edge of the abdomen, just below the tegmina.

Tegmina lying flat on the back largely concealed beneath the sides of scutellum, proportionately small, about one-fourth at outer basal portion coriaceous and densely opaque occupying triangular space at posterior edge of prothorax and sides of scutellum, the remaining part very delicate vitreous and smoky transparent, veins hardly distinguishable.

Abdomen large, fitting snugly beneath and reaching apex of scutellum.

Legs strong, tibiæ not dilated; tarsi tri-articulate, ending in two strong claws.

Type, *E. tuberculata*, Godg.

I take pleasure in dedicating this genus to my esteemed friend Mr. W.W. Froggatt, Government Entomologist, who has rendered every assistance in my entomological studies.

E. TUBERCULATA, sp.nov.

(Plate i., figs. 17, 18 and 19).

♂. Fuscous, with apical half of head, a spot on each side of the median carina in front, the inferior surface of the lateral horns, a band between their bases, base of their spines, lateral posterior edge and median carina of dorsal horn, a spot on each side of the abdomen, and posterior tibiæ sordid yellow; chest black.

Long. ♂ 4: *lat. incl. lat. corn.* 3 mm.

♀ Similar to male, but larger.

Long. 4½; lat. incl. lat. corn. 3½ mm.

Described from one ♂ and one ♀.

Types in Coll. F.W.G.

Hab.—Wingham, N.S.W. (Froggatt).

This interesting species, in general appearance, reminds one of the genus *Tragopa*, Burm.; in that genus, however, the prothorax covers the entire upper surface of the body, including the scutellum.

Porcorhinus, gen.nov.

Head large, porrect, quadrangular, superior surface nearly horizontal, lightly convex and furnished with a strong median longitudinal carina; ocelli below a line passing through centre of the prominent eyes, nearer to each other than to the eyes.

Prothorax, for some distance from the base, convex, nearly horizontal, conforming to the base of the porrect head, after which it is broadened, vertical, and produced above each lateral angle in a large, triquetrous, conical, ear-shaped horn, which extends upward, outward and forward, the apex turned a little backward; the dorsum is very broad between these horns, and destitute of a median longitudinal carina; destitute of a posterior process, the posterior edge deeply and broadly sulcate forward.

Scutellum as long as broad, the apex pointed, base rounded.

Tegmina long, broad, reticulate with numerous venules; clavus very broad at base, gradually acuminate to apex, with two veins.

Wings very large, nearly equal in size to the tegmina, with four apical cells, the first and third very long, the second shortest.

Legs very long, femora slender, cylindrical and curved; tibiæ slender, quadrilateral, the posterior pair with a row of denticles along the posterior edge; tarsi normal.

Type, *P. Mastersi*, Godg.

This genus reminds one of Amyot & Serville's *Nessorhinus*, but differs in being destitute of a posterior process and a dorsal horn; and of *Coloborrhis*, Germ., but differs in having lateral horns.

P. MASTERSI, sp.nov.

(Plate i., figs. 12, 15 and 16).

♂. Head ferruginous, mottled with yellow.

Prothorax ferruginous red, with a broad yellow band passing across the front.

Scutellum sordid yellow.

Tegmina with basal third yellow, punctured with ferruginous, the middle third ferruginous, the veins darker, the apical third clearer.

Abdomen salmon colour, genital apparatus tawny.

Femora tawny, apex black; tibiæ and tarsi tawny.

Long. ♂ 9; lat. 1½.; incl. lat. corn. 3½ mm.

The female is sordid green, the tips of the lateral horns brown.

Described from one male and one female.

Types, ♂ Coll. F.W.G.; ♀ Macleay Museum, Sydney.

Hab.—Sydney (Masters); Mt. Victoria, N.S.W. (Lea).

The head and prothorax, when seen from the side, resemble the head of a pig.

Dedicated to Mr. Masters, Curator of the Macleay Museum, Sydney, who first brought this species to my notice.

EXPLANATION OF PLATE I.

Fig. 1.—*Sertorius giganticus*, tegmina.
Fig. 2.—*Sextius virescens* ,,
Fig. 3.—*Sertorius areolatus* ,,
Fig. 4.—*Lubra regalis* ,,
Fig. 5.—*Eufrenchia Leæ* ,,
Fig. 6.—*Dannus Tasmaniæ* ,,

Fig. 7.—*Acanthucus trispinifer*, tegmina.
Fig. 8.—*Terentius convexus*, tegmina.
Fig. 9.—*Lubra regalis*, prothorax.
Fig. 10.—*Eutryonia monstrifera*, side view.
Fig. 11.— ,, ,, back view.
Fig. 12.—*Porcorhinus Mastersi*, front view.
Fig. 13.—*Acanthucus rufiventris*, side view.
Fig. 14.—*Terentius convexus*, side view.
Fig. 15.—*Porcorhinus Mastersi*, side view.
Fig. 16.— ,, ,, wing.
Fig. 17.—*Eufroggattia tuberculata*, wing
Fig. 18.— ,, ,, dorsal surface.
Fig. 19.— ,, ,, tegmina.
Fig. 20.—*Daunus Tasmaniæ*, pupa.
Fig. 21.—*Dingkana borealis*, tegmina.
Fig. 22.—*Eutryonia monstrifera*, prothorax.
Fig. 23.—Unknown, West Aust.; pupa.
Fig. 24.—*Sextius depressus*, pupa.
Fig. 25.—*Daunus vitta*, tegmina.
Fig. 26.—*Eutryonia monstrifera*, tegmina.

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REVISION OF AUSTRALIAN LEPIDOPTERA.

By A. J. Turner, M.D., F.E.S.

Under this heading I hope to publish a series of papers similar to the present, not taking the different families in any definite order, but as time and opportunity permit. In so doing I must necessarily be largely dependent for my material on others, and in the preparation of the present instalment I must acknowledge my indebtedness to Messrs. F. P. Dodd, of Townsville, R. Illidge and H. Tryon, of Brisbane, G. Lyell, of Gisborne, and O. Lower, of Adelaide, who have presented or lent me specimens for description.

Fam. NOTODONTIDÆ.

Head usually hairy. Tongue sometimes weak or absent. Maxillary palpi obsolete. Thorax hairy beneath. Femora hairy. Posterior tibiæ usually with two, sometimes with one, pair of spurs. Anterior tibiæ usually with a groove bare of scales on under surface. Forewings with vein 1*b* furcate at base, 1*c* absent, 5 from middle or above middle of cell, 7, 8, 9 stalked, 10 out of 8 + 9 or connected with 8 + 9 to form an areole, 11 free. Hindwings with two internal veins, 3 and 4 approximated at base, 5 usually imperfect from middle of cell, rarely absent, 6 and 7 usually stalked, 8 closely approximated to cell as far as middle, usually to near end of cell, sometimes connected with cell by a bar.

This is a very natural family. Superficially some of its members resemble the *Noctuidæ*, but there is not really any close relationship. The two families may always be distinguished by the origin of vein 5 of the forewings. On the other hand, the *Notodontidæ* are closely allied to the more primitive forms of the

Geometridæ belonging to the subfamilies *Monocteniana* and *Selidoseminæ* and to the *Eupterotidæ*. The characters usually given to separate it from these families are not wholly satisfactory, and the matter is one requiring further research. From the *Geometridæ* the *Notodontidæ* may usually be distinguished by the weakly-developed vein 5 of the hindwings in conjunction with the approximation of vein 8 of the hindwings nearly to the end of the cell, but this test is not an absolute one. In case of doubt the frequency with which vein 11 of the forewing is connected with veins 12 and 10 in the *Geometridæ* will probably prove valuable, as so far as I know these anastomoses do not occur in the *Notodontidæ*. For this reason I refer *Xylina serrata*, Wlk., (Brit. Mus. Cat. xi. p. 761) and *X. obscura*, Wlk., which in the British Museum Collection are placed as belonging to an undescribed genus of *Notodontidæ*, to the former family. The genus *Capusa*, Wlk. (Brit Mus. Cat. xi. p. 626), has also been placed among the *Notodontidæ* in the British Museum Collection, but it differs from all members of the family, so far as I know, in vein 10 of forewings being free and not connected with 9. Mr. D. Goudie, of Birchip, Victoria, has bred the larvæ and states that they are geometriform. I think, therefore, that this genus also should be referred to the *Geometridæ*.

The *Eupterotidæ* are distinguished in Hampson's tabulation by the absence of the tongue, but this organ in the *Notodontidæ* is frequently very weak and sometimes appears to be absent. I cannot assert positively that this is actually so, as my material does not permit me to establish this point by dissection; but in any case the distinction appears unsatisfactory. Usually the divergence of vein 8 of hindwings from near base of cell in the *Eupterotidæ* is a satisfactory test, but it breaks down in the genus *Epicoma*, Hb., in which, however, as in other genera of that family, vein 10 of the forewings is wanting. It is, of course, evident that the investigation of family characters cannot be satisfactorily carried out on a local fauna.

The family, without being one of the largest, is yet of considerable extent, being especially well represented in South America, and fairly so in North America, Europe and India. Sir George Hampson, in his 'Moths of India,' enumerates 113 species (excluding *Cyphanta*). In Australia it is but poorly represented, only some 30 species being at present known. This number is doubtless destined to be increased, as the moths are usually of very retired habits, and only readily obtained by rearing the larvæ; but the family will never be very prominent in our fauna.

The internal classification of the family is a matter of considerable difficulty owing to the variability of certain details of the venation. For instance, in a series of seven specimens of *Destolmia lineata*, Wlk., vein 6 of the forewings arises in four specimens from the areole, and in three specimens from the upper angle of the cell. In a series of eight specimens of the European *Phalera bucephala*, Linn., vein 10 of the forewings arises either from the areole,* or from 8 + 9 beyond the areole, and veins 3 and 4 of the hindwings may be either separate, connate, or stalked. Facts of this kind deprive the tabulation given in the 'Moths of India' (Vol. i., p. 124) of much of its value; and I have had in fact to create several new genera which may ultimately prove to be synonyms, when the Indian and Australian genera undergo systematic revision.

Among the Australian genera, *Hyleora*, *Neola*, *Sorama*, *Œnosanda*, *Danima* and *Discophlebia* appear to be endemic. *Teleclita* (probably), *Spatalia*, *Cerura*, *Phalera* and *Gargetta* are found in India, some of them ranging also to Europe and even to America. Of *Pheressaces*, *Pheraspis*, *Themerastis*, *Gallaba*, *Osica* and *Cascera* it would be premature, in the present state of our knowledge, to make any statement.

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* The areole may be, and is by different authors, regarded as being formed either by an independent bar developed between veins 10 and 8+9, or by vein 9 arising from 10 and anastomosing with 8. Which view may be correct is a nice morphological problem. This discrepancy is apt to cause confusion in the descriptions, and I think it is more convenient to write of the veins as arising from or beyond the areole, as the case may be. This can give rise to no misconception if it be borne in mind that, strictly speaking, the areole is formed by the connection of the proximal portions of the veins.

When the larval stages are better known (as, for instance, in North America as portrayed by Packard in the Memoirs of the National Academy of Sciences, Washington, 1895), they may be of help in elucidating the relationship of the genera. Larval characters are always to be viewed with caution, as they are so liable to adaptive modification, but in the present family they are more likely to be of use than elsewhere.

TABULATION OF THE GENERA.

- A. Forewings with no areole, vein 10 stalked with 8+9... 5. *Teleclita.*
- AA. Forewings with vein 10 connected with 8+9 to form an areole.
  - B. Forewings with a well-marked dorsal tooth of scales.......... 4. *Spatalia.*
  - BB. Forewings without a dorsal tooth.
    - C. Palpi short, porrect.
      - D. Thorax with an anterior crest.
        - E. Hindwings with vein 8 connected by a bar with cell.......... 3. *Sorama.*
        - EE. Hindwings with vein 8 approximated but not connected with cell.
          - F. Crown of head crested, ♂ antennæ pectinated to apex.
            - G. Forewings with vein 10 from 8+9 beyond areole.......... 1. *Hyleora.*
            - Forewings with vein 10 from areole. 2. *Neola.*
          - FF. Crown of head not crested, ♂ antennæ with apical half simple. 10. *Destolmia,*
      - DD. Thorax not crested, or with posterior crest only.
        - E. Forewings with vein 6 from end of areole. 6. *Cerura.*
        - EE. Forewings with vein 6 from before end of areole.
          - F. Face with a rounded prominence...... 8. *Œnosanda.*
          - FF. Face without a rounded prominence.
            - G. Antennæ with basal ⅔ pectinated in both sexes, apices simple.......... 7. *Pheressaces.*
            - GG. Antennæ of ♂ pectinated towards base only, of ♀ simple.......... 9. *Danima.*
            - GGG. Antennæ of ♂ pectinated to apex or nearly so.

H. Tongue weak or absent........ 11. *Pheraspis.*
HH. Tongue well developed...... 12. *Themerastis.*
GGGG. Antennæ of ♂ not pectinated.
H. Palpi hairy...................... 13. *Phalera.*
HH. Palpi not hairy............... 14. *Discophlebia.*
CC. Palpi long, second joint slightly ascending, terminal joint porrect.......................... 15. *Gallaba.*
CCC. Palpi long, recurved, terminal joint ascending.
D. Thorax with an anterior crest.................. 16. *Ecnomodes.*
DD. Thorax not crested or with posterior crest only.
E. Forewings with areole broadly lozenge-shaped......... .... 17. *Gargetta.*
EE. Forewings with areole narrow.
F. Forewings with veins 7 and 10 arising from 8+9 beyond areole, which is short .... 18. *Osica.*
FF. Forewings with veins 7 and 10 arising from areole, which is long...... ..... 19. *Cascera.*

Gen. 1. HYLEORA.

[ὑληωρός, a forest-ranger.]

Hylæora, Dbld., P.Z.S. 1848, p. 117.

Head clothed with dense hairs, including a pair of long tufts from base of antennæ which form a crest on crown. Eyes naked. Tongue well developed. Palpi short, porrect, clothed with long dense hairs beneath; terminal joint short, abruptly truncate. Antennæ of ♂ pectinated to apex or nearly so. Thorax densely hairy above and beneath, with a high, erect, anterior crest, continuous with a lower, dense posterior crest. Abdomen hairy, with long hairs on mid-dorsum and at sides. Legs with femora densely hairy; posterior tibiæ with two pairs of spurs. Forewings with vein 2 from $\frac{4}{5}$, 3 from before angle, 5 from above middle of cell, 6 from upper angle of cell or from areole near base, 7 from areole, 10 from 8+9 beyond areole. Hindwings with 3 and 4 separate, 6 and 7 stalked, 8 approximated to near end of cell.

Type *H. eucalypti*, Dbld.

This and the following two genera are closely allied.

	Hindwings brownish or *fuscous*	2.
	Hindwings whitish	*dilucida.*
2.	Forewings with a very short, sharply defined basal longitudinal streak	*eucalypti.*
	Forewings with a long median whitish suffused streak	*inclyta.*

1. HYLEORA EUCALYPTI.

Hylæora eucalypti, Dbld., P.Z S. 1848, p. 117, pl. v.
Hyleora sphinx, Feld., Reise Nov. pl. xcvi., fig. 4.

♂♀. 90-112 mm. Closely allied to *H. inclyta*, Wlk., but anterior part of thorax irrorated with whitish; costal and dorsal portions of forewings irrorated with whitish, without suffused median longitudinal whitish band; a very short distinctly outlined white basal streak; a circular white mark on dorsal portion of base enclosing a dark fuscous centre, partly irrorated with white, and outlined externally with dark fuscous; the posterior dentate line outlined posteriorly by a whitish line; terminal portion of disc suffused with whitish; hindwings brownish, towards inner margin ochreous.

There has been some not unnatural confusion between this and the following species. I am indebted to Mr. J. A. Kershaw for the loan of specimens for examination. Though I consider them distinct, some corroborative evidence as to their larvæ and possible range of variation would be acceptable.

N.S.W.—Vic. Melbourne.

2. HYLEORA INCLYTA.

Sorama inclyta, Wlk., Trans. Ent. Soc. 1862, p. 79.

♂♀ 85-110 mm. Head, palpi, and thorax dark fuscous, mixed with whitish and ochreous. Antennæ whitish, pectinations pale ochreous. Abdomen deep ochreous, base of dorsum (sometimes), tuft, and lower surface dark fuscous. Legs dark fuscous mixed with whitish. Forewings elongate-triangular, costa nearly straight in basal half, thence strongly arched, apex round-pointed, termen markedly oblique, scarcely rounded; dark fuscous, with sparsely scattered whitish scales; a broad white suffused streak from base above fold, containing a few black scales, narrowing to a point before middle; between this and dorsum is a dark grey suffusion; a short outwardly oblique blackish mark across centre of white streak, beneath which is an inwardly oblique streak towards dorsum; a fine oblique dark fuscous acutely dentate posterior line, edged with whitish posteriorly, more or less well marked, followed by a whitish suffusion which extends to apex. Hindwings with apex round-pointed, termen rounded; dark fuscous-brown, toward base suffused with ochreous; cilia dark fuscous-brown.

Type in Oxford Museum.

N.S.W.—Vic. Melbourne—Tas.—S.A.

3. HYLEORA DILUCIDA.

[Dilucidus, clear; in allusion to the hindwings.]

Hyleora dilucida, Feld., Reise Nov. pl. xcvi., fig. 5.

♂ 72-84 mm. Head dark fuscous; face and palpi brown. Antennæ whitish-ochreous. Thorax dark fuscous with a few brown scales. Abdomen deep ochreous; tuft fuscous. Legs fuscous-brown. Forewings elongate, costa straight in basal ⅔, strongly arched towards apex, apex rounded, termen straight, crenate, with strong projections on veins; dark fuscous, posterior part of disc suffused with pale fuscous; scales mostly slender and hair-like, with the exception of an elongate patch of large broad grey and black scales along fold; an obscure acutely dentate blackish transverse line from costa at ¼; an acutely dentate oblique blackish line from ¾ costa to ⅔ dorsum; a subterminal series of elongate grey marks between veins, edged posteriorly with blackish; cilia dark fuscous. Hindwings with termen rounded, slightly wavy; white, on inner margin ochreous-tinged; a very small fuscous suffusion at apex; cilia white, bases fuscous, opposite veins mostly fuscous.

Vic. Birchip, in April (Goudie)—S.A. Adelaide, in May (Lower).

Gen. 2. NEOLA.

Neola, Wlk., Brit. Mus. Cat. v. p. 1033.

Head densely rough-haired, a pair of longer tufts from base of antennæ sometimes uniting to form a crest on crown. Eyes naked. Tongue well developed. Palpi short, porrect; second joint with long dense hairs beneath; terminal joint short, abruptly truncate. Antennæ in ♂ bipectinated to apex or nearly so. Thorax densely hairy above and beneath, with a high erect anterior crest. Abdomen with long hairs on base of dorsum. Femora densely hairy; posterior tibiæ with two pairs of spurs. Forewings with vein 2 from ⅔, 3 from before angle, 6 from areole near base, 7 from end of areole, 10 from areole. Hindwings with 3 and 4 separate, 6 and 7 stalked, 8 approximated to near end of cell.

Type, *Neola semiaurata*, Wlk.

Differs from *Hyleora* only in vein 10 of forewing, which is connected by a bar with 8 + 9 opposite 7, whereas in *Neola* 10 anastomoses with 8 + 9 for some distance beyond 7. So far as my limited material goes this difference seems, in this instance, to be constant. Should it ultimately prove to be variable the two genera would have to be united.

1. Hindwings golden-ochreous .... *semiaurata*.
Hindwings reddish-brown .... *capucina*.

4. NEOLA SEMIAURATA.

Neola semiaurata, Wlk., Brit. Mus. Cat. v. p. 1033; Hch.-Sch., Ausser. Schmet. f. 549.

♂♀. 54-76 mm. Head and palpi brown-fuscous, with a few whitish scales. Antennæ brown-whitish, in ♀ darker. Thorax dark fuscous mixed with brown, irrorated with whitish especially on posterior surface of crest. Abdomen golden-ochreous; basal hairs, apex and lower surface brown. Legs brown; tarsi annulated with whitish. Forewings elongate-oval, costa slightly arched in ♂, more strongly in ♀, apex rounded, termen obliquely rounded; dark fuscous mixed with brown and whitish; two whitish spots arranged longitudinally above mid-disc, resting on a median dark fuscous longitudinal streak; a white suffusion on mid-termen, and another on tornus; sometimes a smaller white suffusion on base of dorsum; cilia dark fuscous mixed with white. Hindwings with termen rounded; golden-ochreous; a broad fuscous terminal band narrowing to a point at tornus; cilia fuscous, apices whitish.

Type in British Museum.

Q. Brisbane—N.S.W. Sydney (Walker). Also, according to Walker, from Tasmania.

5. NEOLA CAPUCINA.

Hyleora capucina, Feld., Reise Nov. pl. 98, f. 1.

♂ 60 mm. Head and palpi brown; side-crests on crown white. Antennæ whitish, pectinations brown. Thorax dark brown; posterior surface of crest whitish. Abdomen pale ochreous-brown, basal segment darker. Legs brownish. Forewings elongate-oval, costa moderately arched, apex rounded, termen rounded, oblique; dark brown; a broad whitish streak along costa from base, narrowing towards apex; a similar broader streak along dorsum, narrow near base; some whitish suffusion near termen; cilia [abraded]. Hingwings with termen rounded; reddish-brown; cilia [abraded].

Vic. Melbourne (Felder); Gisborne, in January, one specimen in poor condition in Coll. Lyell.

Gen. 3. SORAMA.

Sorama, Wlk., Brit. Mus. Cat. v. p. 1034.

Head rough-haired, side-crests moderate. Eyes naked. Tongue well developed. Palpi short, porrect; second joint densely hairy beneath; terminal joint very short, obtuse. Antennæ in ♂ bipectinated, apical third simple; in female simple. Thorax densely hairy above and beneath, with a small median and a separate posterior crest. Femora densely hairy beneath;

posterior tibiæ with two pairs of spurs. Forewings with vein 2 from $\frac{3}{5}$, 3 from well before angle, 6 from upper angle of cell or from near base of areole, 7 from end of areole, 10 from areole. Hindwings with 3 and 4 separate, 6 and 7 stalked, 8 approximated to beyond middle of cell, and connected with cell by a bar before middle.

Type, *Sorama bicolor*, Wlk.

Differs from *Neola* in the bar connecting vein 8 of hindwings from cell, the less pronounced anterior thoracic crest, and the pectinations of antennæ of ♂ not extending to distal third.

6. SORAMA BICOLOR.

Sorama bicolor, Wlk., Brit. Mus. Cat. v. p. 1034.

♂♀. 52-74 mm. Head and palpi brown. Antennæ whitish-ochreous, Thorax dark fuscous mixed with brown, with lustrous reflections. Abdomen pale reddish-brown. Legs reddish-brown. Forewings elongate-oval, costa slightly arched in ♂, moderately in ♀, apex round-pointed, termen slightly rounded, very oblique, crenulate; dark fuscous mixed with reddish-brown, with lustrous reflections, in ♀ mostly reddish-brown; a pale dentate line near base, obsolete towards dorsum; a similar line from $\frac{1}{4}$ costa to $\frac{1}{4}$ dorsum; an acutely dentate pale line from $\frac{2}{3}$ costa to $\frac{2}{3}$ dorsum; cilia dark fuscous. Hindwings with termen rounded, wavy; pale reddish-brown; cilia reddish-brown, apices paler.

Type in British Museum.

Q. Gympie (Illidge)—Vic. Gisborne (Lyell). According to Walker also from Tasmania.

Gen. 4. SPATALIA.

[σπαταλός, riotous; probably from the restlessness of the imago when confined in a small box.]

Spatalia, Hb., Verz. p. 145.

Head shortly rough-haired. Eyes naked. Tongue present. Palpi short, porrect, rough-haired beneath; terminal joint very short. Antennæ with a large fan-like tuft of scales on anterior aspect of basal joint in both sexes; in ♂ pectinated [to apex ?], in ♀ with short pectinations (⅔) towards base, laminate towards apex, with tufts of short cilia. Thorax with an acute anterior crest behind collar. Posterior tibiæ with two pairs of spurs. Forewings with dorsal margin incised, a tuft of scales at each extremity of incision, anterior tuft larger; vein 2 from near angle, 3 from angle, 6 from upper angle, 7 from areole, 10 from 8 + 9 beyond areole. Hindwings with 3 and 4 separate, 6 and 7 stalked, 8 closely approximated to cell to ¾.

Type, *S. argentina*, Schiff., from Europe (Hampson).

7. SPATALIA COSTALIS.

Spatalia costalis, Moore, Lep. Atk. p. 69.

♀ 54 mm. Head, palpi, and antennæ fuscous brown. Thorax fuscous brown, posterior surface of crest whitish. Abdomen fuscous mixed with ochreous-whitish. Legs fuscous, irrorated and tarsi annulated with ochreous-whitish. Forewings elongate triangular, costa moderately arched, apex round-pointed, termen slightly rounded, oblique, dorsum with a short concavity beyond middle, on its anterior extremity a large squarish tuft of scales, on its posterior a small triangular tuft, fuscous brown; a very broad whitish streak occupies costal half of wing, bounded beneath by a line from mid-base to termen at ⅓; this is irregularly suffused with brownish and fuscous, its lower edge is straight with a short projecting tooth in middle, before this it gives off a short bifurcating whitish streak along veins 2 and 3; dorsal portion of disc shows an angulated whitish line bordered with dark fuscous from costal streak to dorsum at ¼; a similar line to dorsum at ⅔; a row of whitish subterminal lunules edged posteriorly with dark fuscous; cilia and dorsal tufts fuscous brown. Hindwings pale fuscous, towards base ochreous-whitish; cilia pale fuscous, towards tornus whitish.

N.Q. Townsville, in March; one specimen received from Mr. F. P. Dodd. Also from India.

Gen. 5. TELECLITA, gen.nov.

[τηλεκλειτός, far-famed.]

Head with loosely appressed scales; side-tufts moderate. Eyes naked. Tongue weak. Palpi moderate, porrect, shortly hairy beneath; terminal joint moderate, hairy. Antennæ in both sexes bipectinated, apical $\frac{1}{5}$ simple. Thorax with a very small posterior crest. Abdomen with a small crest on dorsum of first segment. Femora and tibiæ densely hairy; anterior tibiæ with a deep naked groove on internal surface; posterior tibiæ with two pairs of short spurs. Forewings with vein 2 from $\frac{3}{4}$, 3 from before angle, 6, 7, 8, 9, 10 stalked; no areole; 10 out of 8 + 9 before 7. Hindwings with 3 and 4 separate, 6 and 7 stalked, 8 approximated to near end of cell.

Differs from *Pheosia*, Hb., in the origin of vein 10 of forewings before 7. In neuration it agrees with *Fentonia*, Butl., as defined by Hampson ('Moths of India', i. p. 147) but the palpi appear to be different.

8. TELECLITA CYDISTA, n.sp.

[Κύδιστος, most glorious.]

♂♀. 56-76 mm. Head whitish-grey with a black longitudinal line; face and palpi dark fuscous irrorated with whitish. Antennæ whitish-grey, pectinations fuscous. Thorax whitish-grey with a central black stripe, at each side of which at posterior extremity is a small white spot. Abdomen grey; tuft whitish-grey; basal crest black. Legs grey; anterior and middle tarsi blackish anteriorly. Forewings elongate, proportionately broader in ♀, costa gently arched, apex round-pointed, termen rounded, very oblique; grey mixed with whitish and suffused especially towards base and apex with pale brownish; markings dark fuscous; a very short longitudinal streak from mid-base; a short broad transverse streak from costa at $\frac{1}{8}$; a similar streak from costa at $\frac{1}{4}$; a short outwardly-oblique grey streak from mid-costa; two short oblique streaks from costa at $\frac{5}{8}$, the first grey, the second dark fuscous; a longitudinal streak from just before apex towards or joining third costal streak; a very fine almost obsolete line from fifth costal streak nearly to termen, whence it is continued as a well-marked dark fuscous line three times acutely dentate on veins to dorsum at $\frac{4}{5}$, and prolonged along dorsum towards base; cilia grey, interrupted by whitish opposite veins. Hindwings with termen gently rounded; white; a pale fuscous suffusion on costa to apex; a blackish triangular or roundish blotch at tornus; cilia grey, on tornal blotch blackish.

N.Q. Townsville, from March to June; five bred specimens received from Mr. Dodd.

This species very closely resembles *Pheosia strigata*, Moore, from India, which is doubtless congeneric. In the present species the thorax is grey; in *strigata* the thoracic white dots do not appear to be developed and the costal streaks on forewing are less oblique.

The larva, I am informed, feeds on a species of *Terminalia*; it is green with brown markings, and has four pairs of claspers and a backwardly curved dorsal protuberance on the third thoracic segment. The terminal abdominal segments are turned right over the back, their under surface, which is uppermost, is flattened and shaped something like a leaf. The larva spins a hard nut-like cocoon, and the head end of the pupa is provided with a terminal spike. Mr. Dodd has sent me a specimen of this extraordinary larva and one of the pupa preserved in spirit.

Gen. 6. CERURA.

[Apparently from *κηρός* wax, and *οὐρα* a tail; probably in allusion to the pink protrusible filaments of the larva.]

Cerura, Schrank, Fauna Boica, ii. pt. ii. p. 155.

Head rough-haired. Eyes naked. Tongue weak. Palpi short; porrect, clothed with long hairs; terminal joint concealed. Antennæ with basal joint covered with long hairs, pectinated to apex in both sexes. Posterior tibiæ without middle spurs. Forewings with retinaculum bar-shaped in male, vein 2 from $\frac{4}{5}$, 3 from angle, 5 from near upper angle, 6 from end of areole, 10 from areole or from 8+9 before 7. Hindwings with 3 and 4 separate, 6 and 7 stalked, 8 connected by a bar with middle of cell.

Type, *Cerura furcula*, Schrank, from Europe (Hampson). A very natural genus from which *Dicranura*, Boisd., is unnecessarily separated by some authors.

9. CERURA AUSTRALIS.

Cerura australis, Scott, Aust. Lepid. pl. v.

♂ 66 mm. Head white. Palpi black. Antennæ blackish irrorated, and towards base suffused, with white; pectinations fuscous brown. Thorax white with nine lustrous peacock-blue spots arranged in two transverse rows of four each, the lateral spots being on bases and apices of patagia, the ninth spot is near posterior end of thorax. Abdomen dark fuscous; extreme base, a dorsal median line, and apical segment whitish; the last crossed by a blackish line. Legs white; anterior surface of anterior tibiæ and anterior and middle tarsi except at base black; middle and posterior tibiæ spotted with black; posterior tarsi black with white annulations. Forewings elongate-triangular, costa nearly straight, apex rounded, termen rounded, oblique; white with black dots arranged in transverse lines; a dot at base; a broken row of dots from $\frac{1}{10}$ costa to $\frac{1}{4}$ dorsum; a row of large dots with pale centres from $\frac{1}{3}$ costa to before mid-dorsum; four rows of dots posterior to this, the dots on costa being larger than those on disc; in the most posterior of these the dots are confluent towards costa; a row of longitudinally elongate terminal dots between veins; cilia short; white, on dots black. Hindwings with termen rounded; white, thinly scaled; a series of blackish dots on termen, the largest opposite tornus; a dark fuscous suffusion along inner margin.

N.S.W. Ash Island, near Newcastle (Scott).

This species appears to be local for I am not aware that it has been met with elsewhere. Scott's beautiful figure shows the larva to be closely similar to the European *C. vinula*, Linn.

Gen. 7. PHERESSACES, gen.nov.

[φερεσσακής, a shield-bearer.]

Head with appressed scales. Eyes naked. Tongue absent. Palpi short, porrect. Antennæ with basal ⅔ pectinated in both sexes, apical third simple. Posterior tibiæ with two pairs of spurs. Forewings with rectinaculum bar-shaped in ♂; vein 2 from ⅘, 3 from angle, 5 from above middle of cell, 10 from 8 + 9, or from areole. Hindwings with 3 and 4 separate, 6 and 7 stalked, 8 approximated to end of cell.

Type, *P. cycnoptera*, Low.

10. PHERESSACES CYCNOPTERA.

[κύκνος a swan, πτερόν a wing.]

Notodonta cycnoptera, Low., Trans. R. Soc. S.A. 1894, p. 78.

♂ ♀ 32-41 mm. Head, thorax, and antennæ grey. Palpi clothed with long hairs beneath; dark fuscous, internal surface whitish. Abdomen grey. Legs whitish-grey, tarsi annulated with fuscous. Forewings elongate-oval, costa moderately arched, apex round-pointed, termen rounded, very oblique; vein 10 from 8 + 9 beyond areole; grey irrorated with white; markings blackish; a short outwardly oblique line from costa near base, acutely angulated beneath costa, and again nearer base; a whitish basal suffusion bounded by a fine dentate line, sometimes obsolete, from costa at ¼, forming a long narrow outward loop beneath costa, and ending in dorsum at ⅓; a well marked line from ⅔ costa, inwardly oblique, narrowing in disc, and continued by short streaks on veins to dorsum beyond middle; this is immediately followed by a whitish line; an obscure dentate whitish subterminal line; an interrupted blackish terminal line; cilia grey mixed with whitish. Hindwings with termen rounded, slightly sigmoid towards tornus; white; a fuscous blotch at apex continued as a band or line along termen to tornus; cilia white.

Type in Coll. Lower.

N.Q. Townsville, in February—Q. Duaringa.

Mr. F. P. Dodd has bred the larvæ which are pale green, smooth, cylindrical, with two tails nearly an inch long, each containing a protrusible filament.

11. Pheressaces spirucha, n.sp.

[*σπειροῦχος*, containing a circle.]

♂ 38 mm. Head and thorax grey. Palpi clothed with short appressed hairs; dark fuscous. Antennæ ochreous-whitish. Abdomen grey. Legs grey. Forewings elongate, costa slightly arched, apex round-pointed, termen rounded, very oblique; vein 10 from areole; grey, towards costa irrorated by dark fuscous; veins narrowly blackish; a slightly waved transverse blackish line near base; a second similar line from ⅔ costa to mid-dorsum, connected on costa with an outwardly curved line to dorsum near tornus, the two forming an incomplete circle; cilia grey. Hindwings with termen rounded; whitish, on costa suffused with fuscous, cilia white.

This species differs slightly in the scaling of the palpi and neuration from the preceding, and the posterior legs are broken, so its generic position is not quite assured.

Type in Coll. Agricultural Department, Queensland.

Q. Brisbane; one specimen.

Gen. 8. ŒNOSANDA.

Œnosanda, Wlk., Brit. Mus. Cat. vii. p. 1713.

Head shortly rough-haired; face with a rounded horny prominence, naked in the centre. Eyes naked. Tongue obsolete. Palpi very short, clothed with long hairs beneath; terminal joint obsolete. Antennæ in ♂ bipectinated to apex, in ♀ simple. Abdomen in ♀ with a dense hairy tuft at apex. Posterior tibiæ with two pairs of spurs. Forewings with vein 2 from ⅝, 3 from angle, 5 from middle of cell, 6 from about or beyond middle of areole, 7 from areole or from 8 + 9 shortly beyond areole, 10 from areole. Hindwings with 3 and 4 connate or stalked, 5 obsolete, 6 and 7 long-stalked or 6 absent, 8 approximated to near end of cell.

Contains only the following species.

Newman spelt the generic name *Œnosandra*, referring it to Walker and giving no description. In the British Museum Catalogue Walker describes it as *Œnosanda.*

12. ŒNOSANDA BOISDUVALII.

♀. *Œnosandra boisduvalii*, Newm., Trans. Ent. Soc. n.s. iii. p. 286.
♂. *Teara* (?) *terminalis*, Wlk., Brit. Mus. Cat. vii. p. 1733.
♂. *Pterygosoma squamipunctum*, Feld., Reise Nov. pl. 98, f. 7.

♂ 44-50 mm. Head and palpi fuscous. Antennæ fuscous, basal joint with a terminal white ring, pectinations whitish-ochreous. Thorax fuscous, in centre mixed with white. Abdomen black, apices of segments on dorsum and tuft bright ochreous. Legs fuscous, tarsi annulated with white. Forewings elongate, costa moderately arched, apex rounded, termen rounded, very oblique; grey, irrorated with dark fuscous along costa; scattered in disc are very large black and ochreous scales; cilia grey. Hindwings with termen rounded; whitish, towards base and inner margin fuscous; a fuscous discal spot; a narrow grey terminal line; cilia whitish, on tornus and inner margin fuscous.

♀ 46-58 mm. Head and thorax white. Palpi fuscous. Antennæ dark fuscous, basal joint white. Abdomen as in ♂ but tuft much larger and paler. Legs fuscous brown; tibiæ and tarsi dark fuscous with white annulations. Forewings shaped as in male; pure white; costa narrowly fuscous; a broad central black streak prolonged at base to dorsum, containing a few white and ochreous scales, and reaching almost to apex; cilia white. Hindwings and cilia white.

Vic. Gisborne, in March; received from Mr. S. Lyell.

Gen. 9. DANIMA.

Danima, Wlk., Brit. Mus. Cat. v. p. 1053.

Head shortly rough-haired. Eyes naked. Tongue well developed. Palpi short, porrect; second joint with long hairs beneath; terminal joint minute, pointed. Antennæ in ♂ with basal half pectinated, apical half simple; in ♀ simple. Thorax with loose hairs forming a slight posterior crest. Posterior tibiæ with two pairs of spurs. Forewings with 2 from $\frac{3}{4}$, 3 from shortly before angle, 6 from upper angle of cell or from near base of areole, 7 from end of areole or from 8 + 9 near areole, 10 from areole. Hindwings with 3 and 4 closely approximated at base, 6 and 7 stalked, 8 approximated to near end of cell.

Type, *Damina banksiæ*, Lew.

13. DANIMA BANKSIÆ.

Bombyx banksiæ, Lew., Lepid. N.S.W. (1822) pl. ix.

♂♀. 58-84 mm. Head and palpi fuscous. Antennæ whitish-ochreous, stalk towards apex dark fuscous. Thorax dark fuscous with a few white and ochreous scales; patagia white with a few ochreous scales. Abdomen bright ochreous; three terminal segments and under surface dark fuscous; apical hairs of ♀ whitish. Legs dark fuscous. Forewings in ♂ elongate, in ♀ elongate-triangular, costa in ♂ straight to near apex, in ♀ moderately arched, apex rounded, termen rounded, strongly oblique; grey with sparsely scattered large triangular white scales; markings blackish irrorated with ochreous; a small spot beneath costa near base; a larger spot on costa at $\frac{1}{4}$; a broad streak from mid-costa obliquely outwards, becoming longitudinal in disc, not reaching termen; a small suffused spot on costa at $\frac{5}{6}$; a fuscous suffusion on base of dorsum; three spots on fold, sometimes suffusedly connected with dorsum; cilia grey. Hindwings with termen gently rounded; in ♂ whitish, suffused with fuscous towards inner margin; in ♀ wholly fuscous; cilia in ♂ whitish, in ♀ fuscous with whitish apices, on inner margin mixed with ochreous.

Q. Brisbane, in January—Vic. Melbourne (Lyell).

Gen. 10. DESTOLMIA.

Destolmia, Wlk., Brit. Mus. Cat. v. p. 991.

Head shortly rough-haired. Eyes naked. Tongue well developed. Palpi short, porrect; second joint densely scaled beneath; terminal joint concealed. Antennæ of ♂ bipectinated to about middle, terminal half simple; of ♀ simple. Thorax with a rounded anterior crest, and a small rounded sometimes bifid posterior crest. Posterior tibiæ with two pairs of spurs. Forewings with vein 2 from $\frac{2}{3}$, 3 from well before angle, 6 from upper angle of cell or from areole near base, 7 from end of areole, 10 from end of areole or from 8 + 9 beyond areole. Hindwings with 3 and 4 separate, 6 and 7 stalked, 8 approximated to beyond middle of cell.

Type, *D. lineata*, Wlk.

1. Forewings with transverse lines more or less obsolete, acutely dentate.. *lineata.*
Forewings with three very distinct transverse lines, not dentate *nigrolinea.*

14. DESTOLMIA LINEATA.

Destolmia lineata, Wlk., Brit. Mus. Cat. v. p. 992.
Collyta lanceolata, Wlk., Brit. Mus. Cat. xxxii. p. 452.
Notodonta cinerea, Luc., Proc. Roy. Soc. Qsld. 1891, p. 78.

♂ ♀ 48-60 mm. Head and palpi whitish-grey. Antennæ in ♂ whitish, pectinations ochreous-tinged, in ♀ fuscous. Thorax whitish-grey, collar suffused with brownish. Abdomen grey. Legs whitish-grey. Forewings elongate-triangular, costa slightly arched in ♂, more strongly in ♀, termen slightly rounded, wavy, very oblique; whitish-grey; an indistinct, strongly dentate, dark fuscous transverse line from $\frac{1}{4}$ costa to $\frac{2}{5}$ dorsum; a similar posterior line from about mid-costa obliquely outwards, acutely angled in disc and continued to mid-dorsum; a variably developed series of fine black streaks between veins in posterior part of disc; cilia grey. Hindwings with termen slightly rounded, wavy; pale grey; cilia grey, apices white.

Type in British Museum.

Q. Brisbane. Walker gives also Sydney and Swan River as localities, but the latter requires confirmation.

Somewhat variable; *D. lanceolata*, Wlk., has a dark fuscous suffusion from base of dorsum to mid-termen; other specimens have a median dark fuscous suffusion.

15. DESTOLMIA NIGROLINEA.

Notodonta nigrolinea, Luc., Trans. Nat. Hist. Soc. Qsld. 1894, p. 107.

♀ 50 mm. Head, thorax, and palpi grey, finely irrorated with white. Antennæ ochreous-grey. Abdomen grey, apical segments finely irrorated with whitish. Legs grey, tarsi dark fuscous, irrorated with whitish. Forewings elongate, costa nearly straight except near base and apex, termen bowed; grey finely irrorated with whitish-grey; veins finely outlined with blackish; with three blackish transverse lines; first from $\frac{1}{6}$ costa to $\frac{1}{6}$ dorsum, nearly straight; second from $\frac{2}{5}$ costa to $\frac{2}{5}$ dorsum, slightly sigmoid, third from $\frac{2}{3}$ costa to before tornus, slightly outwardly curved near costa; a dark fuscous linear mark in disc above middle between second and third lines; a dark grey subterminal suffusion, posteriorly finely dentate, from costa two-thirds across disc; cilia grey. Hindwings with termen rounded; whitish, thickly covered with grey hairs, especially towards inner margin; cilia dark grey, apices white.

Type in Coll. Lucas.

Q. Brisbane, in February; one specimen taken at light.

Gen. 11. PHERASPIS, gen.nov.

[φέρασπις, a shield bearer.]

Head rough-haired. Eyes naked. Tongue weak or absent. Palpi short, or moderate, porrect or slightly ascending; terminal joint short. Antennæ in ♂ pectinated to apex, in ♀ shortly pectinated or simple. Thorax with a slight posterior crest. Posterior tibiæ with two pairs of spurs. Forewings with 2 from $\frac{4}{5}$, 3 from angle; 6 from areole before or near middle, 7 from 8 + 9 beyond areole, 10 from areole. Hindwings with 3 and 4 separate or connate, 6 and 7 stalked, 8 approximated to cell.

Type, *P. polioxutha*, Turn.

1.	**Hindwings tawny**	**2.**
	Hindwings not tawny	***spodea.***
2.	**Forewings with a longitudinal blackish streak from base**	***mesotypa.***
	Forewings without median streak	***polioxutha.***

16. PHERASPIS POLIOXUTHA, n.sp.

[πολιός grey, and ξουθός tawny.]

♂ ♀ 44-56 mm. Head, palpi, and thorax whitish-grey. Antennæ whitish, bipectinated in both sexes. Abdomen deep ochreous; the three terminal segments dark grey. Legs whitish-grey; anterior tarsi dark fuscous annulated with whitish. Forewings elongate-triangular, costa moderately arched, apex rounded, termen rounded, oblique; whitish-grey, lines fuscous; a short, sometimes dentate, line from $\frac{1}{8}$ costa, slightly outwardly curved, not reaching dorsum; an acutely dentate line from $\frac{1}{4}$ costa to $\frac{1}{3}$ dorsum; a small fuscous suffusion on mid-costa sometimes produced across disc as a faint suffused line; a finely dentate line from $\frac{3}{4}$ costa, slightly sigmoid, to $\frac{2}{3}$ dorsum; a subterminal series of dots more or less developed, and an interrupted terminal line; cilia whitish-grey. Hindwings with termen rounded; whitish-ochreous, sometimes suffused with fuscous, towards inner margin ochreous, terminal area sometimes suffused with greyish; cilia whitish-ochreous.

Type in Coll. Turner.

N.Q. Townsville, in February; two bred specimens received from Mr. F. P. Dodd. There is an example from Cardwell in the Queensland Museum, and another from Cooktown in Coll. Lyell.

17. PHERASPIS MESOTYPA, n.sp.

[μέσος middle, τύπος a mark, impression.]

♂ ♀ 48-50 mm. Head whitish, mixed with a few grey hairs on crown. Palpi brown. Antennæ ochreous-whitish; in ♀ simple. Thorax whitish mixed with grey. Abdomen orange-ochreous. Legs whitish; anterior pair brown anteriorly. Forewings elongate-oval, costa gently arched, apex rounded, termen rounded, oblique, whitish irrorated with grey; a well marked dark fuscous streak from base along fold to $\frac{2}{3}$, thence continued obliquely by a series of short longitudinal streaks to apex; a faint interrupted grey line close to termen; cilia whitish mixed with grey. Hindwings with termen rounded; grey; towards base and inner margin ochreous; cilia grey, on inner margin ochreous.

Type in Coll. Agricultural Department, Queensland.

N.Q. Townsville, in January and February; two specimens received from Mr. F. P. Dodd. Also from Thursday Island.

The palpi are rather longer than in *P. polioxutha*, and the second joint with shorter hairs.

18. PHERASPIS SPODEA, n.sp.

[σποδός ashes; ash-coloured.]

♀. 50 mm. Head white; face white with a transverse brown line near upper edge. Palpi white, external surface brown. Antennæ brown; in ♀ simple. Thorax with a small posterior crest; whitish, with a brown transverse line across collar. Abdomen whitish, dorsum of basal segments suffused with brownish. Legs whitish; anterior pair brown anteriorly. Forewings elongate-oval, costa moderately arched, apex rounded, termen rounded, oblique; whitish sparsely irrorated with grey; lines grey, suffused; first from costa at $\frac{1}{3}$ obliquely outwards, angulated inward near costa, to dorsum at $\frac{1}{3}$; second from costa at $\frac{3}{5}$, first outwardly curved then slightly sigmoid to dorsum at $\frac{2}{3}$; an indistinct subterminal line, edged posteriorly with white, angulated three times in disc; cilia grey, interrupted with whitish on veins; apices whitish. Hindwings with termen rounded; grey, at apex and tornus whitish; cilia whitish-grey.

Type in Coll. Turner.

Q. Brisbane, in January; one perfect specimen taken at light.

Gen. 12. THEMERASTIS, gen.nov.

[θεμερός grave, serious.]

Head shortly rough-haired; face rounded, somewhat projecting. Eyes smooth, partly overlapped by a tuft of long hairs from posterior inferior quadrant. Tongue well developed. Antennæ in ♂ bipectinated to apex. Palpi very short, porrect; terminal joint minute. Thorax with a slight posterior crest. Posterior tibiæ with two pairs of spurs. Forewings with vein 2 from near angle, 6 from areole near end, 10 from end of areole. Hindwings with 3 and 4 separate, 6 and 7 stalked, 8 approximated to near end of cell.

Distinguishable from *Pheraspis* by the well developed tongue, rounded projecting face, and origin of vein 6 of forewings from near end of areole.

19. THEMERASTIS CELAENA, n.sp.

[*κελαινός* dark, blackish.]

♂. 45 mm. Head, palpi, and thorax dark fuscous. Antennæ grey. Abdomen grey mixed with dull ochreous. Legs grey. Forewings elongate, costa strongly arched, apex rounded-rectangular, termen rounded, oblique; dark fuscous-grey, lines blackish; two parallel, slightly wavy, outwardly curved transverse lines near base; a fine slightly wavy outwardly curved line from ¼ costa to mid-dorsum; this is preceded near costa by a small circular blackish ring, and followed at mid-disc by a larger oval ring; a fine line from ¾ costa several times angulated in disc to ¾ dorsum; traces of a pale subterminal line; a fine dark terminal line; cilia grey. Hindwings with termen rounded; whitish, towards termen suffused with dark fuscous; cilia fuscous.

Type in Coll. Lyell.

Vic. Melbourne; one specimen.

Gen 13. PHALERA.

[*φαληρός* with a pale or whitish head.]

Phalera, Hb., Verz. p. 146.

Head shortly rough-haired. Eyes naked. Tongue present. Palpi short, porrect, densely hairy beneath; terminal joint very short. Antennæ of ♂ laminate with fascicles of cilia; of ♀ simple. Thorax with a small posterior crest. Anterior tibiæ with a naked groove on underside; posterior tibiæ with two pairs of spurs. Forewings with vein 2 from ⅔, 3 from angle, 6 from areole, 7 from end of areole or from beyond areole, 10 from 8 + 9 beyond areole or from areole. Hindwings with 3 and 4 separate, connate, or stalked, 6 and 7 stalked, 8 approximated to near end of cell.

Type, *P. bucephala*, Linn., from Europe.

20. PHALERA RAYA.

Phalera raya, Moore, Lep. E. I. Co. p. 433; Butl., Ill. Het. vi., pl. ciii., fig. 1.

Phalera grotei, Moore, *op. cit.*, p. 434.

Phalera cossoides, Wlk., Trans. Ent. Soc. 1862, p. 80.

Acrosema amboinæ, Feld., Reise Nov. pl. xcvi., fig. 2.

♀. 65 mm. Head pale ochreous, lower half of face brown. Palpi pale ochreous, external surface irrorated with brown. Thorax reddish-brown mixed with white; collar and a squarish anterior blotch brownish-ochreous. Abdomen fuscous. Legs fuscous mixed with whitish; anterior femora with anterior surface pale ochreous edged externally with brown. Forewings elongate-triangular, costa moderately arched, apex rounded, termen rounded, crenulate, strongly oblique; reddish-brown irrorated with white, the white scales preponderating towards dorsum; lines fuscous-brown; an outwardly curved transverse line near base and another at 1/8; traces of a median line; a posterior line from costa at 3/4, at first inwardly curved, then angulated in disc and slightly wavy to dorsum at 3/4; a large subtriangular ochreous-brown blotch between posterior line and apex; a white suffusion at tornus; an indistinct subterminal line; cilia reddish-brown mixed with white. Hindwings with termen rounded; fuscous; a suffused paler posterior line; cilia fuscous mixed with whitish.

N.Q. Cape York, one specimen in the Queensland Museum; Cooktown, one specimen in Coll. Illidge. Also from Amboyna (Felder) and India.

Gen. 14. DISCOPHLEBIA.

[δίσκος, a plate, disc, φλέψ, a vein; with veined disc.]

Discophlebia, Feld.

Head smooth. Eyes smooth, overlapped by a tuft of long hairs arising from posterior inferior quadrant. Tongue well developed.

Palpi short, porrect, with loosely appressed scales beneath, not hairy; terminal joint very short. Antennæ of ♂ laminate with fascicles of cilia, of ♀ simple. Thorax not crested. Anterior tibiæ with a naked groove on underside, overlapped by a proximal tuft of hairs; posterior tibiæ with two pairs of spurs. Forewings with vein 2 from $\frac{5}{6}$ to $\frac{7}{8}$, 3 from angle, 6 from middle or beyond middle of areole, 7 from end of areole, 10 from areole. Hindwings with 3 and 4 separate, 6 and 7 stalked, 8 approximated to near end of cell.

In structure this resembles *Phalera*, Hb., but differs in the smooth head and palpi, and in the origin of vein 2 of forewings from nearer angle of cell.

Type, *Discophlebia catocalina*, Feld.

1. Hindwings with a broad white terminal band.................... *catocalina*.
   Hindwings without a broad white terminal band............... 2.
2. Hindwings with termen narrowly white.......................... *bloserodes*.
   Hindwings with termen not white.................................. *lucasii*.

21. DISCOPHEBLIA CATOCALINA.

[Probably from a supposed resemblance to the genus *Catocala*.]

Discophlebia catocalina, Feld., Reise Nov. pl. 96, f. 8.

♂. 48 mm. Head grey, vertex whitish-grey. Palpi dark fuscous mixed with grey. Antennæ grey. Thorax grey, collar dark grey. Abdomen dark fuscous; tuft ochreous-whitish. Legs dark grey mixed with whitish. Forewings elongate-oblong, costa strongly arched, apex rounded-rectangular, termen slightly oblique, rounded towards tornus; grey, near base suffused with whitish; lines blackish; an irregularly waved line from $\frac{1}{4}$ costa to $\frac{2}{5}$ dorsum; a short outwardly-oblique streak from costa at $\frac{2}{3}$; a pale circular discal spot succeeds first line, and a larger spot, faintly outlined in fuscous, is situated at apex of the oblique streak; a posterior line from before mid-costa very obliquely outwards, obtusely bent in disc to become transverse, and ending in dorsum at $\frac{3}{4}$; veins beyond this streaked with blackish; cilia whitish-grey, intersected by continuations of streaks on veins. Hindwings with termen rounded; dark fuscous; a broad white terminal band narrowing to a point before tornus; cilia white, on tornus and inner margin dark fuscous.

Vic. Birchip, in May, one specimen in Coll. Lyell—S.A. Adelaide (Felder).

22. DISCOPHLEBIA BLOSYRODES, n.sp.

[βλοσυρωδης, of stern appearance.]

♀. 43 mm. Head grey, with a blackish line across crown, and another across middle of face. Palpi and antennæ grey. Thorax grey; patagia tipped with dark fuscous. Abdomen dark fuscous; apical segments pale ochreous. Legs grey. Forewings elongate-oval; costa very strongly arched, termen obliquely rounded; iron-grey; veins partly finely outlined with black; lines black, a short basal line from costa, not reaching but produced parallel to dorsum for a short distance; a thick nearly straight line from $\frac{1}{8}$ costa to $\frac{1}{4}$ dorsum; a finer line from costa slightly beyond this, outwardly curved to mid-dorsum; a third line from costa before middle to $\frac{3}{4}$ dorsum, obtusely angled in disc; cilia whitish-grey, narrowly intersected with blackish opposite veins. Hindwings with termen rounded; dark fuscous; termen narrowly white except at tornus; cilia as forewings, but on tornus and inner margin dark fuscous.

Type in Coll. Turner.

N.Q. Townsville, in October; one specimen received from Mr. F. P. Dodd.

23. DISCOPHLEBIA LUCASII.

Discophlebia lucasii, Rosen., Ann. Mag. Nat. Hist. 1885, p. 421, pl. xi., f. 4.

Type in British Museum.

I have before me a specimen from Victoria which I believe to belong to this species, but as the identification is not quite certain I forbear to describe it.

Gen. 15. GALLABA.

Gallaba, Wlk., Brit. Mus. Cat. xxxii. 457.

Head rough-haired; face with projecting cone of hairs. Eyes naked. Tongue well developed. Palpi long ($2\frac{1}{2}$ times breadth of eye); second joint very long, somewhat ascending, rough-haired above and beneath; terminal joint well developed, loose-haired, porrect. Antennæ in both sexes bipectinated to apex. Thorax smooth; but patagia long, dense-scaled, projecting upwards and backwards as far as posterior edge of thorax. Abdomen with a small basal crest on dorsum of first segment. Anterior tibiæ in both sexes with a naked groove overlapped by a dense tuft of hairs on posterior surface; posterior tibiæ with two pairs of spurs. Forewings with vein 2 from $\frac{4}{5}$ or from near angle, 3 from angle, 5 from slightly below middle of cell, 6 from areole, 7 from areole near apex, 10 from areole. Hindwings with 3 and 4 separate, 6 and 7 stalked, 8 approximated to near end of cell.

Type, *Gallaba duplicata*, Wlk.

A very distinct genus easily recognised by the peculiar palpi and patagia.

1. Forewings dark brown.. *duplicata.*
Forewings grey.. *ochropepla.*

24. GALLABA DUPLICATA.

[Duplicatus, doubled; perhaps in allusion to the patagia.]

Gallaba duplicata, Wlk., Brit. Mus. Cat. xxxii. 458.

♂♀. 37-40 mm. Head and palpi fuscous-brown mixed with whitish. Antennæ ochreous-whitish, near base fuscous-brown mixed with white; bases of pectinations blackish. Thorax fuscous-brown with a few whitish scales; apices of patagia darker. Abdomen pale fuscous or whitish; basal crest dark fuscous-brown. Legs whitish; anterior pair fuscous, tarsi annulated with whitish. Forewings oblong, costa strongly arched at base, thence nearly straight, apex rounded-rectangular, termen rounded, slightly oblique; fuscous-brown mixed with whitish and a few reddish-brown scales; anterior and posterior lines faintly indicated; a blackish dot margined with whitish in costal part of disc before middle, with sometimes two or three similar smaller dots in a transverse line between it and dorsum; an elongate transverse black dot margined with whitish on mid-disc, sometimes obsolete;

sometimes a series of dark crescentic marks posteriorly edged with whitish, forming a subterminal line; cilia fuscous. Hindwings with termen sigmoid; fuscous sometimes inclining to whitish; cilia concolorous.

Type in British Museum.

Q. Brisbane, in May; one specimen (♂) in Queensland Museum and one (♀) in Coll. Illidge.

25. GALLABA OCHROPEPLA, n.sp.

[ὠχρός, pale; πέπλος, a cloak.]

♀. 38 mm. Head white mixed with grey on vertex. Palpi white. Antennæ grey, base of stalk white. Thorax grey mixed with white. Abdomen whitish. Legs whitish; anterior pair grey mixed with white. Forewings elongate; costa moderately arched, apex pointed, termen slightly rounded, oblique; whitish-grey, irrorated with grey, centre of disc suffused with white, a small oblique fuscous streak close to mid-base, closely succeeded by a similar streak in disc; two parallel grey lines, rather outwardly curved, from $\frac{1}{4}$ costa to $\frac{1}{3}$ dorsum; two similar parallel lines, interrupted in disc from $\frac{2}{3}$ costa to $\frac{3}{4}$ dorsum; a series of dark grey streaks forming an interrupted subterminal line; cilia grey mixed with whitish-grey. Hindwings with termen sigmoid; pale grey; cilia pale grey.

Type in Coll. Lyell.

Vic. Ocean Grange, near Sale, in January; one specimen.

Gen. 16. ECNOMODES, gen.nov.

[ἐκνομώδης of unusual appearance.]

Head rough-haired. Eyes naked. Tongue obsolete. Palpi shortly rough-scaled, in ♂ recurved and reaching to vertex; in ♀ rather shorter, porrect; terminal joint moderate, bent forwards. Antennæ pectinated to apex in both sexes. Thorax with an erect anterior crest. Posterior tibiæ with two pairs of spurs; anterior tibiæ in ♂ with a long tuft of hairs beneath. Forewings with vein 2 from $\frac{3}{5}$, 3 from well before angle, 6 from near base of areole, 7 from end of areole, 10 from areole. Hindwings with 3 and 4 widely separate at base, 6 and 7 stalked, 8 approximated to cell to beyond middle.

Type, *E. sagittaria*, Luc.

26. ECNOMODES SAGITTARIA.

[Sagittarius, marked with arrows.]

Chlenias sagittaria, Luc., Proc. R. Soc. Qsld. 1899, p. 148.

♂♀. 34-40 mm. Head brown; face whitish with a brown transverse line across forehead. Palpi brown, internal surface whitish. Antennæ whitish; stalk in ♂ brownish. Thorax whitish mixed with brown. Abdomen whitish. Legs whitish; anterior pair dark brown. Forewings elongate-triangular, costa moderately arched, apex rounded, termen rounded, oblique; whitish with some brownish irroration, markings dark fuscous; a subcostal streak more or less distinct from base to ⅔, connected with costa at ⅓ and beyond middle; a short streak from near base along fold; a suffused median streak from ¼, interrupted beyond middle, and continued to apex; an acutely dentate line from median streak beyond interruption to dorsum at ¾; fine streaks along veins near apex; cilia whitish mixed with brownish. Hindwings with termen rounded; whitish, towards termen suffused with pale fuscous; cilia whitish mixed with fuscous except on inner margin.

Type in Coll. Lucas.

Q. Brisbane.

Gen. 17. GARGETTA.

Gargetta, Wlk., Brit. Mus. Cat. xxxii. p. 455.

Head with loosely appressed hairs. Eyes smooth, partly covered (in *G. acarodes*) by a tuft of long hairs arising from margin in lower posterior quadrant. Tongue well developed. Palpi ascending, not quite reaching vertex; second joint with loosely appressed scales; terminal joint short. Antennæ bipectinated to apex in both sexes. Thorax not crested. Posterior tibiæ

with two pairs of long spurs; anterior tibiæ in ♂ with a naked groove beneath, partly overlapped by a posterior crest of scales. Forewing in ♂ with a long tuft of hairs from base of dorsum beneath; vein 2 from $\frac{4}{5}$, 3 from well before angle, 6 from upper angle of cell immediately below areole, 7 from 8 + 9 just below areole, 10 from areole, which is broadly lozenge-shaped, extending as much before and beyond end of cell. Hindwings with 3 and 4 connate, 6 and 7 stalked, 8 closely approximated to cell to beyond middle.

Type, *G. costigera*, Wlk., from India.

27. GARGETTA ACARODES, n.sp.

[ἀκαρώδης, rather small.]

♂♀. 28-30 mm. Head pale fuscous. Palpi dark fuscous. Antennæ whitish, pectinations ochreous-tinged. Thorax pale fuscous mixed with whitish. Abdomen pale fuscous. Legs fuscous; tarsi with obscure paler annulations. Forewings elongate, costa moderately arched, apex rounded, termen slightly rounded, oblique; pale fuscous irrorated with white, markings dark fuscous; a narrow streak from base to mid-disc, nearer costa than dorsum; a squarish spot on costa at $\frac{1}{3}$; a small spot beyond this both on costa and dorsum; a strongly waved line situated in a narrow white suffusion from costa at $\frac{2}{3}$ to dorsum at $\frac{3}{4}$; beyond this costa and veins are streaked with dark fuscous; two whitish dots on apical $\frac{1}{4}$ of costa; a faintly marked white subterminal line interrupting streaks on veins; a series of dark fuscous terminal dots; cilia white, bases barred with dark fuscous. Hindwings somewhat elongate, termen slightly sigmoid; grey, towards termen darker; cilia whitish.

Type in Coll. Turner.

N.Q. Townsville, in March and May; two specimens received from Mr. F. P. Dodd.

Gen. 18. OSICA.

Osica, Wlk., Brit. Mus. Cat. xxxiii. 766.

Head with loosely appressed scales. Eyes naked. Tongue well developed. Palpi long, recurved, reaching or exceeding vertex; second joint with a dense projecting anterior tuft at apex; terminal joint moderate in ♂, rather long in ♀, smooth-scaled. Antennæ simple, in ♂ ciliated. Thorax with a slight posterior crest. Abdomen with a small dorsal crest on first segment. Anterior tibiæ with a groove beneath completely overlapped by a posterior tuft of scales; posterior tibiæ with two pairs of large scales. Forewings with vein 2 from $\frac{3}{4}$, 3 from well before angle, 6 from near end of areole, which is small, 7 from 8 + 9 well beyond areole, 10 from 8 + 9 beyond 7. Hindwings with 3 and 4 connate, 6 and 7 stalked, 8 closely approximated to beyond middle of cell.

Type, *O. glauca*, Wlk.

Our knowledge of structure has advanced somewhat since Walker described this genus among the *Noctuidæ*, with the remark that it had some resemblance to the *Galleridæ*.

28. OSICA GLAUCA.

[γλαυκός, greenish.]

Osica glauca, Wlk., Brit. Mus. Cat. xxxiii. 767.

♂♀. 46-60 mm. Head and antennæ pale brownish. Palpi fuscous-brown, terminal joint pale brownish. Thorax brown-whitish, in ♀ greenish-grey mixed with brown; collar brown. Abdomen grey. Legs brownish; antérior tarsi dark fuscous, ends of joints narrowly white. Forewings elongate, costa moderately arched, apex rectangular, termen slightly rounded, slightly oblique; brownish suffused with brown-whitish or grey; with numerous darker brown indistinct transverse lines, mostly represented by dots on veins; a large pale squarish discal spot margined anteriorly and posteriorly by dark brown; shortly beyond this is a fine sigmoid dentate line from $\frac{3}{5}$ costa to mid-dorsum; a subterminal series of dark brown dots; a fine interrupted dark fuscous terminal line; cilia brown-whitish mixed with dark brown. Hindwings about twice breadth of forewings, termen rounded; dark grey; cilia grey.

Type in British Museum.

Q. Brisbane, in August.

Gen. 19. CASCERA.

Cascera, Wlk., Brit. Mus. Cat. xxxii. p. 460.

Head rough-haired. Eyes naked. Tongue well developed. Palpi recurved, ascending, reaching vertex; second joint very long, anteriorly rough-scaled; terminal joint moderate. Antennæ in ♂ bipectinated, apical ¼ simple; in ♀ simple. Thorax with a small posterior crest. Posterior tibiæ with two pairs of spurs. Forewings with 2 from ¾, 3 from angle, 6 from areole before or beyond middle, 7 from end of areole or from 8 + 9 beyond areole, 10 from areole. Hindwings with 3 and 4 separate, 6 and 7 stalked, 8 approximated (sometimes anastomosing) to beyond middle of cell.

Type, *C. muscosa*, Wlk.

1. Forewings partly green. .... *muscosa*.
Forewings without green markings.................................. *amydra*.

29. CASCERA MUSCOSA.

[Muscosus, mossy.]

Cascera muscosa, Wlk., Brit. Mus. Cat. xxxii., p. 461.

♀. 54 mm. Head and palpi brown mixed with whitish; vertex ochreous-tinged. Antennæ brown. Thorax brown mixed with pale green. Abdomen brownish-grey. Legs brown mixed with whitish; anterior pair greenish-tinged. Forewings elongate-triangular, costa rather strongly arched, apex rounded, termen obliquely rounded, crenulate, brown mixed with grey, whitish, and green forming very complex markings which are probably variable; costa barred with dark brown and greenish; an irregular green patch near base, and an irregular broad median green band; a whitish spot on costa at ⅜, and another in dorsal part of disc at ⅗; beyond median green band is a dark brown band, its outer edge distinct and crenated; beyond this is a subterminal series of green spots edged posteriorly first by whitish, then by dark brown; cilia greenish. Hindwings with termen rounded, wavy; brownish-grey; two or three whitish spots in a line parallel to inner margin near tornus; cilia whitish with a greenish median line.

Type in British Museum.

Q. Brisbane; one specimen in Coll. Illidge.

Walker gives "Swan River, from Mr. Diggles' Collection," as the origin of this species, but this locality is certainly erroneous.

30. Cascera amydra, n.sp.

[αμυδρός, dark.]

♂♀. 40-48 mm. Head whitish mixed with brownish-ochreous. Palpi brown. Antennæ brown, pectinations dark fuscous. Thorax dark brownish-grey, collar light brownish-ochreous. Abdomen grey. Legs brown mixed with whitish. Forewings elongate-oblong, costa moderately, in ♀ strongly arched, apex rounded, termen rounded, slightly oblique; brown suffused and irrorated with grey; a transverse dark brown line near base, and another from ¼ costa to ⅖ dorsum; a small brown discal spot above mid-disc, in ♂ this is edged beneath by white, and preceded in disc by a larger white spot, an indistinct posterior line from ¾ costa to ¾ dorsum; a subterminal row of small circular blackish spots; cilia brownish. Hindwings with termen rounded; grey; cilia grey.

The white markings on forewing of ♂ are probably inconstant and variable.

Type in Coll. Turner.

N.Q. Townsville, in March and April; two specimens received from Mr. Dodd, of which one (♀) is in Coll. Lyell.

SPECIES UNRECOGNISED OR NOT RIGHTLY INCLUDED IN THIS FAMILY.

31. *Clathe arida*, Wlk., Brit. Mus. Cat. v. p. 994, belongs to the *Lasiocampidæ*.

32. *Nadiasa parvigutta*, Wlk., *op. cit.*, v. p. 1015, belongs to the genus *Pinara* (*Lasiocampidæ*).

33. *Listoca lignaria*, Wlk., *op. cit.*, v. p. 1021, is a synonym of *Clathe arida*, Wlk.

34. *Sorema nubila*, Wlk., } *op. cit.*, v. p. 1065, are also syn-
35. *Sorema contracta*, Wlk., } onyms of *Clathe arida*, Wlk.

36. *Ptilomacra senex*, Wlk., *op. cit.*, v. p. 1099, belongs to the *Zeuzeridæ*.

37. *Destolmia* (?) *liturata*, Wlk., *op. cit.*, xxxii. p. 409. I have not seen the type of this species.

38. *Rilia distinguenda*, Wlk., *op. cit.*, xxxii. p. 435, is a synonym of *Olene mendosa*, Hb., (*Lymantriadæ*).

39. *Rigema tacta*, Wlk., *op. cit.*, xxxii. p. 438, is a synonym of *Psalis securis*, Hb., (*Lymantriadæ*).

40. *Vunga delineata*, Wlk., *op. cit.*, xxxii. p. 453, is a synonym of *Smyriodes aplectaria*, Gn. (*Geometridæ*).

41. *Asteroscopus nodosus*, Swin., Cat. Lep. Oxf. Mus. i. p. 299, is a synonym of *Chlenias banksiaria*, Le G. (*Geometridæ*).

42. *Lomatosticha nigrostriata*, Möschl., Stett. Ent. Zeit. I have not been able to consult this description.

43. *Teinocladia cuculloides*, Feld., is a synonym of *Capusa senilis*, Wlk. (*Geometridæ*).

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Fam. HYPONOMEUTIDÆ.

Under this name it is convenient to describe a small group of genera allied to *Hyponomeuta*, Latr., and *Eustixis*, Hb. = *Mieza*, Wlk., = *Enaemia*, Zel. Some of these forms approach in structure to the *Oecophoridæ*, from which they may be distinguished *inter alia* by the smooth posterior tibiæ. They show, however, much greater variation in the neuration than the latter family. To the *Glyphipterygidæ* they are allied, and Mr. Meyrick merges both into the family *Plutellidæ*. As I am not at present competent to express any opinion as to whether the *Hyponomeutidæ* are to be regarded as a distinct family, I shall not attempt any definition.

The Australian species, of which about twenty are at present known, have hitherto been much confused, although they are all fine and conspicuous insects. In their study I have derived assistance from Walsingham and Durrant's contribution to Swinhoe's 'Catalogue of the Lepidoptera Heterocera in the Oxford Museum' (Vol. ii. p. 558); and I am indebted to Lord Walsingham for permission to describe several species, the types of which are in his Collection. Mr. Lower has kindly lent me for examination the types of two species described by him.

The genus mentioned above, commonly known as *Enaemia*, Zel., which has all the veins separate in both wings, is not at present known to occur in Australia.

TABULATION OF GENERA.

A. Hindwings with vein 4 absent	*Hyponomeuta.*
AA. Hindwings with veins 4 and 5 stalked or connate.	
B. Forewings with veins 7 and 8 stalked	*Epidictica.*
BB. Forewings with veins 7 and 8 separate	*Lactura.*
AAA. Hindwings with veins 4 and 5 separate.	
B. Forewings with veins 2 and 3 stalked	*Epopsia.*
BB. Forewings with veins 2 and 3 separate.	
C. Hindwings with 5 bent and approximated at base to 4	*Hedycharis.*
CC. Hindwings with 5 widely separated at base from 4	*Atteva.*

Gen. 1. HYPONOMEUTA, Latr.

[ὑπό, under, νομεύς, a shepherd; probably from the gregarious habits of the larvæ.]

Head smooth. Antennæ in ♂ simple, very minutely ciliated. Tongue well-developed. Maxillary palpi obsolete. Labial palpi moderate, curved, ascending; second joint with appressed scales; terminal joint about as long as second, stout, tolerably acute, with appressed scales slightly roughened in front. Forewings elongate; with twelve veins, all separate, vein 2 from near angle, 3, 4, 5 approximated at base. Hindwings with vein 4 absent, 5 widely separate from 3, 6 and 7 nearly parallel.

A genus of probably nearly world-wide distribution. The larvæ feed gregariously in a common web. Only two Australian species are known.

1. Forewings whitish-grey, spots near termen confluent	*pustulellus.*
Forewings white, terminal spots discrete	*myriosemus.*

1. HYPONOMEUTA PUSTULELLUS.

Hyponomeuta internellus, Wlk., Brit. Mus. Cat. xxviii. p. 533.
Hyponomeuta pustulellus, Wlk., *op. cit.*, xxviii. p. 533.

♂♀. 22-29 mm. Head white. Palpi black, apex of second joint and more or less of terminal joint white. Thorax whitish-grey, bases of patagia and a pair of median spots black. Abdomen blackish, apices of segments, tuft, and most of underside white. Legs white annulated with black. Forewings narrow-elongate; whitish-grey with numerous black spots; 6 or 7 spots on basal half of costa; a row of six spots above dorsal margin, the last two touching margin near tornus; a row of eight spots above fold; several spots irregularly distributed between this row and apical half of costa; a number of confluent spots near termen; cilia grey, bases blackish. Hindwings considerably broader than forewings; grey; cilia grey, towards tornus white.

Walker described *internellus* on the same page but before *pustulellus*, indicating, however, that the former might be a variety of the latter; so that I presume the second name should be adopted for the species.

Q. Brisbane, Mt. Tambourine and Warwick; in October and November—N.S.W. Sydney (Walker).

2. HYPONOMEUTA MYRIOSEMUS.

[μυρίος, numerous, σῆμα, a mark; many-spotted.]

Hyponomeuta myriosema, Turn., Trans. R. Soc. S.A. 1898, p. 200.

Type in Coll. Turner.

Q. Brisbane and Mt. Tambourine; in August and November.

Gen. 2. ATTEVA.

Atteva, Wlk., Brit. Mus. Cat. ii. 526.

Head smooth. Antennæ in male simple. Tongue well developed. Maxillary palpi obsolete. Labial palpi moderate, curved, ascending, smooth-scaled; terminal joint about as long as second, stout, tolerably acute. Forewings elongate; with twelve veins, all separate, vein 2 from considerably before angle. Hindwings with eight veins, all separate, veins 3, 4, and 5 widely separate, 5, 6, and 7 somewhat approximated at base. Hindlegs of ♂ very slender and the tibiæ without spurs.

A genus of wide distribution, being represented in the tropics of both hemispheres. For its synonymy refer to Swinhoe's

'Catalogue of Eastern and Australian Lepidoptera' (Vol. ii. p.558), *Tineina*, by Walsingham and Durrant.

Type, *Atteva niveigutta*, Wlk., from India.

1.	Hindwings wholly orange	*niphocosma.*
	Hindwings with apical half grey	2.
2.	Forewings with a dark fuscous terminal band	*albiguttata.*
	Forewings without a dark fuscous terminal band	*charopis.*

3. ATTEVA NIPHOCOSMA, n.sp.

[*νίφα*, snow, *κόσμς*, an ornament; adorned with snow-white.]

♀. 25 mm. Head snow-white; a dark fuscous spot on crown. Palpi dark fuscous with some white scales; base of second joint white. Antennæ dark fuscous. Thorax golden-ochreous, with a postmedian snow-white spot; patagia and tegulæ snow-white except at base; a pair of white spots on underside. Abdomen golden-ochreous; on underside with a median row of white spots. Legs dark fuscous, femora and posterior tibiæ golden-ochreous, banded with white. Forewings elongate, costa arched near apex, apex rounded, hindmargin slightly oblique, slightly rounded; golden-ochreous, with numerous snow-white spots of unequal size; a row of 9 or 10 small spots on or near costa; two on dorsum near base; two on dorsum before tornus, of these the first is larger; five unequally-sized spots in disc not regularly arranged; an erect bar from anal angle to near last costal spot; a spot on termen beneath apex; cilia pale ochreous. Hindwings elongate, as broad as forewings; golden-ochreous of brighter shade than forewings; cilia concolorous.

Type in Coll. Turner.

N.Q. Townsville; one specimen in February, received from Mr. F. P. Dodd—Q. Brisbane; one specimen in March.

A. impariguttella, Zel., is an allied species from Ceylon. *A. fabriciella*, Swed. = *niviguttella*, Wlk., from India and China is very similar but distinct. *A. brucea*, Moore, from Java is another closely allied species. *A. emissella*, Wlk., from Borneo, is similar but has grey hindwings. *A. niveigutta*, Wlk., from Assam, has been naturally confounded with *niviguttella*, but is a very different species. I am indebted to Mr. Durrant for this note.

4. ATTEVA ALBIGUTTATA.

[Albus, white, gutta, a drop; with white spots].

Zeller (*teste* Durrant). I have not seen the reference.

Head and face golden-ochreous with white margins. Palpi blackish, bases and apices of joints white. Thorax golden-ochreous, with paired white dots on apices of tegulæ, bases of patagia, and posteriorly. Abdomen golden-ochreous; on underside a median row of white dots. Legs blackish annulated with white. Forewings elongate; golden-ochreous with numerous snow-white spots; ten small spots on costa; ten or eleven in a line beneath costa; five on dorsal margin; and about a dozen of unequal size between dorsum and the preceding row; an erect white bar, sometimes interrupted, from tornus narrowing to costa near apex; beyond this disc is dark fuscous; three minute dots near apex; cilia white. Hindwings dark grey; basal fourth golden-ochreous; cilia grey, on tornus and inner margin golden-ochreous.

Q. Brisbane, in April.

6. ATTEVA CHAROPIS, n.sp.

[χαροπις, bright, joyous.]

♂♀. 26 mm. Head white; posterior edge and a line between antennæ dark fuscous. Palpi white; a band on second joint and on terminal joint towards apex dark fuscous. Antennæ dark fuscous. Thorax golden-ochreous; a double post-median spot and apices of tegulæ snow-white; three pairs of white spots on underside. Abdomen golden-ochreous. Legs dark fuscous banded with white; posterior pair in ♂ whitish-ochreous. Forewings elongate, costa arched near apex, apex rounded. Hind-margin slightly oblique, slightly rounded; golden-ochreous with numerous snow-white spots of unequal; size a minute basal spot; seven to ten small spots on costa, the two penultimate rather larger; a large spot above dorsum near base, and another on dorsum beyond this; three spots on dorsum before tornus, the middle one sometimes connected with a discal spot; four rather large discal spots in longitudinal series; an erect bar from tornus towards last costal spot, sometimes divided into two spots; cilia fuscous, apices paler. Hindwings bright golden-ochreous; apical half dark fuscous; cilia dark fuscous on apical half of termen, thence bright golden-ochreous.

A series including the type in Coll. Walsingham.

N.Q. Cedar Bay, near Cooktown (Meek).

This species resembles though it does not accurately correspond with *A. pulchella*, Moore, a species of doubtful locality. An examination of the type is necessary to establish or contradict its identity.

Gen. 3. EPIDICTICA, gen.nov.

[ἐπιδεικτικός, fit for display, ostentatious.]

Epidictica, Wlsm., MS.

Head smooth. Antennæ of male slightly serrate, very minutely ciliated. Tongue well developed. Maxillary palpi minute. Labial palpi rather short, porrect, with appressed scales; terminal joint as long as second, rather stout, tolerably pointed. Forewings elongate-ovate; vein 2 from near angle, 7 and 8 stalked. Hindwings with veins 4 and 5 stalked or rarely connate, 6 and 7 tolerably parallel.

Type, *E. calliphylla*, Turn.

1.	**Head white**	*cristata.*
	Head orange or reddish	**2.**
2.	**Hindwings reddish**	**3.**
	Hindwings with apical half dark purplish	*pilcheri.*
3.	**Forewings yellowish with numerous red lines**	*calliphylla.*
	Forewings purple-reddish with yellow spots	*thiospila.*

7. EPIDICTICA CALLIPHYLLA, n.sp.

[καλλίφυλλος, with beautiful wings.]

♂♀. 20-24 mm. Head red, sides of crown and lower half of face pale yellow. Palpi and antennæ red. Thorax pale yellow;

two lateral spots and base of collar, a bar across tegulæ, and a broad cruciform mark, red. Abdomen reddish. Legs pale yellowish partly suffused with reddish; anterior pair red, basal half of tibiæ and first tarsal joint pale yellow on external surface. Forewings elongate-oval, costa rather strongly arched, apex rounded, termen obliquely rounded; pale yellow with red lines on veins and on basal portions of costa and inner margin; several longitudinal red lines in disc; an inwardly oblique line of slightly darker colour across basal portion of cell; a similar short inwardly oblique line from end of cell to dorsum; a short outwardly oblique line before apex commencing from vein 9, crossing 7 and 8 at their bifurcation, bent inwards at vein 6 to end on vein 5; cilia red, apices yellowish. Hindwings with termen slightly excavated before tornus; reddish; cilia reddish, in excavation whitish.

This species has been mistaken for *Lactura mactata*, Feld., but the venation should be a sufficient distinction. The oblique line crossing the distal veins is characteristic.

Var. *tenuilinea*.

[Tenuis, slender, linea, a line; with slender lines.]

Differs from the type as follows:—All red markings except cruciform mark on thorax, and oblique lines on forewings much reduced or absent.

Though very different in superficial appearance the markings where traceable agree accurately with type. Both forms were taken together, and I have no doubt they represent the same species.

Type in Coll. Turner.

Q. Brisbane and Mt. Tambourine; a series taken in November.

8. EPIDICTICA CRISTATA.

Cyptasia cristata, Butl., Trans. Ent. Soc. 1886, p. 383.
Enaemia callianthes, Low., Trans. R. Soc. S.A. 1894, p. 111.
Enaemia mixoleuca, Turn., Trans. R. Soc. S.A. 1900, p. 14.

Type in British Museum.

N.Q. Mackay (Lower)—Q. Gympie.

9. EPIDICTICA THIOSPILA, n. sp.

[θεῖον, sulphur; σπῖλος, a spot; with pale yellow spots.]

♂. 27 mm. Head orange; face and palpi yellowish. Antennæ yellowish; towards base orange. Thorax dull purple-reddish; collar and apex of tegulæ pale yellow. Abdomen reddish. Legs reddish. Forewings elongate-oval, costa rather strongly arched, apex rounded, termen obliquely rounded; dull purple-reddish; edge of dorsum, of basal third of costa, and of apical fourth of costa, orange; spots pale yellow; a large triangular spot on costa near base; a smaller spot opposite this on dorsum; a second costal spot at ¾; several small indistinct spots in posterior part of disc; a narrow pale yellow terminal band, its anterior edge indented above middle; cilia pale yellow. Hindwings and cilia reddish; veins 4 and 5 connate.

Type in Coll. Walsingham.

N.Q. *Mackay; one specimen (Meek).*

10. EPIDICTICA PILCHERI.

Calligenia pilcheri, Luc., Proc. Linn. Soc. N.S.W. 1891, p. 279.

♀. 20-22 mm. Head reddish-orange. Palpi reddish-orange. Antennæ blackish, near base reddish-orange. Thorax purple-reddish; two spots on tegulæ and a large posterior spot reddish-orange; apices of patagia and a pair of lateral spots pale yellowish. Abdomen reddish-orange. Legs blackish irrorated with reddish-orange and whitish. Forewings elongate-oval, costa rather strongly arched, apex rounded, termen obliquely rounded; purple-reddish; spots pale yellowish; those on costa and dorsum partly suffused with reddish-orange; a large squarish spot on costa at ¼; a smaller spot on costa at ⅔; an elongate subtriangular spot on mid-dorsum, preceded and followed by a small spot in disc; a small spot before tornus, two terminal spots, and two or three dots in posterior portion of disc; cilia reddish-orange, at tornus interrupted by purple-reddish. *Hindwings* purple-reddish; basal ¼ and costa reddish-orange; cilia purple-reddish, on tornus and inner margin reddish-orange.

Type in Coll. Lucas.

Q. Rockhampton (Lucas), Bundaberg, and Brisbane; in November and March.

No doubt this species is somewhat variable; I have not seen the male.

Gen. 4. LACTURA.

Lactura, Wlk., Brit. Mus. Cat. ii. 485.

Head smooth. Antennæ in male slightly serrate, very minutely ciliated. Tongue well developed. Maxillary palpi minute. Labial palpi rather short, porrect, with appressed scales; terminal joint as long or rather shorter than second, rather stout, tolerably pointed. Forewings elongate-ovate; with 12 veins all separate, 2 from near angle. Hindwings with veins 4 and 5 stalked or rarely connate, 6 and 7 tolerably parallel.

Type, *L. dives*, Wlk.

This genus includes and supersedes *Dianasa*, Wlk., *Themiscyra*, Wlk., and *Cyptasia*, Wlk.

1.	Forewings with numerous red lines parallel to veins..........	2.
	Forewings with veins not outlined with red.....................	6.
2.	Forewings marked with grey.......	3.
	Forewings without grey markings...	4.
3.	Forewings with a large apical grey blotch.......................	*egregiella.*
	Forewings with apex yellowish....................	*laetifera.*
4.	Forewings with oblique purplish lines.......	5.
	Forewings without purple lines..	*erythractis.*
5.	Purplish lines suffused and connected in disc..........	*eupoecila.*
	Purplish lines narrow, separate....	*mactata.*
6.	Forewings with yellow or white blotches on apex and tornus.	*suffusa.*
	Forewings without blotches on apex and tornus.........	7.
7.	Forewings reddish..	*caminaea.*
	Forewings fuscous.	*dives.*

11. LACTURA EGREGIELLA.

[Egregius, distinguished.]

Cyptasia egregiella, Wlk., Brit. Mus. Cat. xxxv. p. 1837.

♀. 22 mm. Head and thorax whitish with reddish markings. Palpi, antennæ and abdomen reddish. Forewings elongate-ovate costa moderately arched, apex rounded, termen obliquely rounded; whitish with reddish lines on veins; a large triangular grey blotch, its apex at mid-costa, its base along nearly the whole of dorsum, containing several whitish spots near dorsum; a large apical grey blotch; cilia whitish. Hindwings and cilia reddish.

My only example is in poor condition, but the above description should be sufficient for recognition.

Type in British Museum.

N.Q.—Q. Wide Bay (Olliff).

Walker gives "Swan River, from Mr. Diggles' Collection," but this is certainly an error. Probably Diggles' specimen was taken near Moreton Bay, Queensland.

12. LACTURA LAETIFERA.

[Laetifer, joyful, pleasing.]

Themiscyra laetifera, Wlk., Brit. Mus, Cat. xxxi. p. 258.
Enaemia pyrochrysa, Low., Trans. R. Soc. S.A. 1894, p. 111.

♂♀. 30-32 mm. Head pale yellow, upper margin of face and middle of crown reddish-orange. Palpi pale yellow. Antennæ reddish-orange. Thorax pale yellow with a central grey stripe bifurcating posteriorly; bases of tegulæ, a spot behind tegulæ, and centres of patagia reddish-orange. Abdomen reddish-orange, beneath pale yellow. Legs pale yellowish; anterior pair reddish-orange; femora tinged with reddish-orange. Forewings elongate-ovate, costa strongly arched, apex rounded, termen rounded, slightly oblique; pale yellow, veins outlined with reddish-orange; with two grey fasciæ interrupting streaks on veins; first fascia from mid-costa to near base of dorsum; second fascia confluent with first on costa, outwardly curved, narrowing in disc, to dorsum at $\frac{2}{3}$, connected by a dorsal streak with first fascia; from it are given off a broad central streak to termen, a short oblique streak to tornus, and a fine streak along dorsum to tornus; cilia pale yellow. Hindwings and cilia reddish-orange.

Type in British Museum.

N.Q. Cairns (Lower)—Q. Bundaberg, Brisbane.

13. LACTURA ERYTHRACTIS.

[ἐρυθρός, red.]

Enaemia erythractis, Meyr., Trans. R. Soc. S.A. 1886, p. 1043.

♂♀. 26-32 mm. Head reddish; sides of crown and face pale yellow. Palpi and antennæ reddish. Thorax pale yellow; an anterior cruciform mark and a posterior spot red; posterior extremity pale yellow; collar narrowly red at base; tegulæ red, apex and a spot near base pale yellow. Abdomen reddish. Legs reddish; internal surfaces yellowish. Forewings elongate-oval, costa rather strongly arched, apex rounded, termen obliquely rounded; pale yellow with red lines; a narrow line along costa to $\frac{3}{5}$; another along inner margin to $\frac{4}{5}$, basal portion broad, median portion sometimes obsolete; a short streak along basal part of vein 12; a streak along vein 11 to costa; cell broadly outlined, incompletely so along submedian, crossed towards base by an oblique line which is prolonged to dorsum at $\frac{1}{4}$; beyond this it is divided by a median line, each division containing a short longitudinal streak; a strong line from end of cell to dorsum at $\frac{4}{5}$; veins 2 to 10 outlined; cilia red, apices pale yellowish. Hindwings and cilia reddish.

Type in Macleay Museum.

N.Q. Townsville, in January, a series received from Mr. F. P. Dodd; Bowen (Meyrick).

Distinguished by its large size and absence of oblique dark lines.

14. LACTURA EUPOECILA, n.sp.

[εὐποίκιλος, variegated.]

♂♀. 23-26 mm. Head red; sides of crown and face pale yellowish. Palpi red, terminal joint pale yellowish. Antennæ reddish. Thorax pale yellow; base of collar, two lateral spots on collar, margins of patagia, and an anterior cruciform mark red; a posterior dot purple-grey; posterior extremity pale yellow. Abdomen red, lower surface, and in ♂ also apex, pale yellow.

Legs pale yellowish suffused with reddish; anterior pair reddish, basal half of tibiæ and first joint of tarsus pale yellow on external surface. Forewings elongate-ovate, costa rather strongly arched, apex rounded, termen obliquely rounded; pale yellow with red lines along veins; two strong oblique purple-grey lines; first from costa at $\frac{2}{5}$ to inner margin near base, narrowly interrupted near costa; second from beneath costa near apex to inner margin at $\frac{3}{4}$, dilated on inner margin and connected with first fascia in disc, its costal half being represented by short streaks on veins; in addition to red lines on veins there are a bisecting line and several other lines in cell, and a line along inner margin, and at base of costa; cilia red, apices pale yellowish. Hindwings and cilia pale reddish; in ♀ deep reddish; veins 3 and 4 short-stalked in ♂, closely approximated in ♀.

A series including the type in Coll. Walsingham.

N.Q. Cedar Bay, near Cooktown (Meek).

There appears to be a constant sexual difference in the colouration of the hindwings and abdomen.

15. LACTURA MACTATA.

[Mactatus, honoured.]

Mieza mactata, F. and R., Reise Nov. pl. cxxxix. fig. 44.

♂♀. 19-20 mm. Head pale yellow, centre of crown reddish; face whitish. Palpi whitish; external surface of second joint reddish. Antennæ red. Thorax pale yellow, margins of tegulæ and patagia and a broad central stripe not reaching posterior extremity red. Abdomen reddish, beneath whitish. Legs pale yellow tinged with reddish; anterior pair mostly red. Forewings elongate-ovate, costa rather strongly arched, apex rounded, termen obliquely rounded, pale yellow with red streaks along veins, and additional longitudinal red streaks in disc; two narrow oblique purple-grey fasciæ; first from dorsum at $\frac{1}{6}$ towards but scarcely reaching costa at $\frac{1}{3}$; second from dorsum at $\frac{3}{4}$ nearly to apex, interrupted in disc, with two narrow processes anteriorly, one on and the other near dorsum, but not reaching first fascia; a narrow red terminal line; cilia pale yellow, bases red. Hindwings and cilia reddish.

N.Q. Cape York (Felder), Kuranda, Geraldton (Johnstone River); in October and November.

Smaller and narrower-winged than the preceding, the fasciæ narrower, not connected, the second fasciæ without processes to termen. Felder's figure is coarse and inaccurate, but may fairly be assumed to represent this species.

16. LACTURA SUFFUSA.

Dianasa suffusa, Wlk., Brit. Mus. Cat. ii. p. 488.
Dianasa (?) *obscura*, Butl., Trans. Ent. Soc. 1877, p. 346.
Hypoprepia haematopus, F. & R., Reise Nov. pl. 139, f. 54, 55.

♂♀. 40-46 mm. Head yellow, in ♀ white. Palpi yellow, in ♀ white, apices fuscous. Antennæ dark fuscous; basal joint yellow, in ♀ white. Thorax red, anterior margin broadly yellow in ♂, white in ♀; patagia except bases in ♂ grey. Abdomen red, beneath ochreous-whitish, sides in ♂ grey. Legs dark fuscous; femora red. Forewings elongate-ovate, costa rather strongly arched, apex rounded, termen slightly rounded, oblique; grey, in ♀ sometimes pale red; a red streak along fold, and another midway between fold and costa, commencing at ¼; a broad yellow stripe along costa to ⅓, terminating abruptly, in ♀ white; costal edge red; a dark red dot in costal stripe near base, and a second elongate spot on lower edge near middle; two red dots above dorsum at ¼ and ½; a triangular blotch at apex and another at tornus, margined in disc by red, yellow in ♂, white in ♀; cilia yellowish, in ♀ whitish. Hindwings and cilia red, in ♂ termen and cilia sometimes suffused with dark grey.

Var. *obscura*, Butl.—♂. Forewings exactly as in type, but ground colour darker. Hindwings and cilia blackish-fuscous. Abdomen above blackish-fuscous, irrorated with red near base.

Q. Brisbane. Felder's locality, Assam, is probably erroneous.

17. LACTURA CAMINAEA.

[*κάμινος*, a furnace; fiery red.]

Enaemia caminaea, Meyr., Proc. Linn. Soc. N.S.W. 1886, p.1044.

Type in Australian Museum.
N.S.W. Newcastle (Meyrick).

18. LACTURA DIVES.

Lactura dives, Wlk., Brit. Mus. Cat. ii, p. 485.

♂♀. 28-32 mm. Head reddish; face pale yellow. Palpi and antennæ black. Thorax blackish; with a large posterior pale yellow spot. Abdomen black; sides red; tuft yellowish. Legs black. Forewings elongate-oval, costa moderately arched, apex rounded, hindmargin obliquely rounded; purple-blackish, with seven rather large roundish pale yellow spots; a spot at base; a second beneath costa at $\frac{1}{3}$; third above dorsum at $\frac{2}{5}$; fourth in disc beyond middle; fifth beneath and internal to fourth; sixth small just above inner margin before tornus; seventh small, somewhat suffused, partly bisected by a dark line on vein in disc at $\frac{5}{6}$; cilia dark fuscous, apical $\frac{2}{3}$ from before apex to middle of termen pale yellow. Hindwings fuscous; basal portion, except near inner margin, reddish; cilia fuscous, with a darker basal line.

Type in British Museum.
N.Q. Townsville, in March; a series bred by Mr. F. P. Dodd.

Gen. 5. EPOPSIA, gen.nov.

[*ἐπόψιος*, conspicuous.]

Head loosely scaled. Tongue present. Palpi short, recurved, smooth-scaled; second joint short; terminal joint $\frac{2}{3}$ second, rather short, tolerably acute, apex just reaching base of antennæ. Antennæ in male simple, with short even ciliations ($\frac{2}{3}$). Thorax smooth. Posterior tibiæ smooth-scaled. Forewings with veins 2 and 3 on a long stalk from angle, 7 and 8 separate, 7 to termen.

Hindwings with disco-cellular sharply angled, 3 and 4 from a point, 5 from middle of cell, 6 and 7 short-stalked.

Very distinct in the stalking of veins 2 and 3 of forewings, and 6 and 7 of hindwings.

19. EPOPSIA METRETA, n.sp.

[μετρητός, measured.]

♂. 20 mm. Head yellow, back of crown red. Palpi red, terminal joint mixed with pale yellow. Antennæ red, towards apex whitish. Thorax red; a central spot and basal ¾ of tegulæ bright yellow. Abdomen reddish. Legs reddish; middle tibiæ and tarsi, and posterior tarsi yellowish. Forewings elongate-oblong, costa moderately arched, apex round-pointed, termen obliquely rounded; dull red; markings bright yellow, an inwardly oblique fascia from costa before middle to dorsum at ⅓; a triangular spot on dorsum before tornus; apical part of termen narrowly pale yellow; cilia red, towards apex pale yellow. Hindwings and cilia red.

Type in Coll. Walsingham.

N.Q. Cedar Bay near Cooktown (Meek).

Gen. 6. HEDYCHARIS, gen.nov.

[ἡδυχαρής, sweetly joyous.]

Head smooth. Tongue present. Palpi short, recurved, with appressed scales; terminal joint shorter than second, pointed. Antennæ of male simple, very minutely ciliated. Forewings elongate-ovate; with twelve veins, 7 and 8 stalked. Hindwings with eight veins, all separate, 5 approximated to 4 at base, 6 and 7 tolerably parallel.

20. HEDYCHARIS PHOENOBAPTA, n.sp.

[φοινός, dark red; βαπτός, dyed.]

♂. 16 mm. Head and palpi orange-reddish. Antennæ blackish. Thorax purplish-red; with a pair of postmedian lateral whitish spots. Abdomen purplish-red; some basal hairs, lower and lateral surfaces orange. Legs whitish mixed with dark fuscous. Forewings elongate-oval, costa rather strongly arched, apex rounded, hindmargin obliquely rounded; purplish-red, markings whitish; a longitudinal line in disc at $\frac{1}{3}$; three small spots in a line above dorsum; a spot close to dorsum before tornus; a dot at end of cell; a broadish line along termen, dilated at extremities, not reaching tornus; cilia purplish-red. Hindwings thinly scaled; purplish-red; some orange hairs near inner margin; cilia purplish-red.

Type in Coll. Turner.

Q. Brisbane; one specimen in March.

SPECIES UNRECOGNISED OR BELONGING TO OTHER FAMILIES.

21. *Mieza* (?) *picta*, F. and R., Reise Nov. pl. 138, f. 49. "Australia, Cape York."
22. *Mieza* (?) *erythrocera*, F. and R., *op. cit.*, pl. 138, f. 53. "Australia, Cape York."
23. *Mieza* (?) *phænodes*, F. and R., *op. cit.*, pl. 139, f. 37. "Australia, Cape York." These three species are unknown to me.
24. *Polynesa maculosa*, Turn., Trans. R. Soc. S.A. 1898, p. 201. I am inclined to refer this genus to the *Gelechiidæ*. The posterior tibiæ are hairy, not smooth-scaled as stated.
25. *Callithauma basilica*, Turn., *op. cit.*, 1900, p. 15. I now refer this genus to the *Œcophoridæ*.
26. *Ceratophysetis sphaerosticha*, Meyr., Proc. Linn. Soc. N.S.W. 1886, p. 1045. This genus should, I think, be referred to the *Œcophoridæ* in the neighbourhood of *Psecadia*. The posterior tibiæ are certainly hairy.
27. *Thyridectis psephonoma*, Meyr., *op. cit.*, 1886, p. 1046. I do not know this species.

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NOTES AND EXHIBITS.

Mr. Kesteven recorded the occurrence in Sydney Harbour of *Asaphis contraria*, Desh. The species was originally described from Bourbon, but has lately (in the Society's Proceedings for 1900, Vol. xxv., p. 731) been recorded from the mouth of the Nambuccra River, N.S.W., by Mr. C. Hedley. Early in January of the present year Miss L. Parkes obtained a single small valve from Balmoral Beach, Sydney Harbour.

WEDNESDAY, APRIL 29TH, 1903.

The Ordinary Monthly Meeting of the Society was held in the Linnean Hall, Ithaca Road, Elizabeth Bay, on Wednesday evening, April 29th, 1903.

Dr. T. Storie Dixson, President, in the Chair.

Messrs. H. I. **Jensen**, Sydney University; and **Walter G. Woolnough**, B.Sc., Adelaide University, were elected Ordinary Members of the Society.

The President announced that, under the provisions of Rule xxv., the Council had elected Professor David, B.A., F.R.S., F.G.S., Mr. Henry Deane, M.A., F.L.S., &c., Mr. J. H. Maiden, F.L.S., and the Hon. James Norton, LL.D., M.L.C., to be VICE-PRESIDENTS; and Mr. J. R. Garland, M.A. (56 Elizabeth Street), to be HON. TREASURER, for the current year.

The Donations and Exchanges received since the previous Monthly Meeting, amounting to 9 Vols., 50 Parts or Nos., 2 Bulletins, 4 Reports, 10 Pamphlets, and 5 Miscellanea, received from 48 Societies, &c., and 3 Individuals, were laid upon the table.

AUSTRALIAN FUNGI, NEW OR UNRECORDED.

DECADES III.-IV.

By D. McAlpine, Corresponding Member.

Of the Fungi here recorded 15 are new species and 14 genera are represented. The Orchids, which are generally comparatively free from fungi, contribute two, one of the genera (*Amerosporium*) being new to Australia. The imported Capeweed, although so common and widespread, is usually particularly clean, but two new species have been found upon it. The Kangaroo Grass has likewise yielded two which are new. It is interesting to find parasitic fungi upon such native parasitic flowering plants as *Cassytha* and *Loranthus*.

The Leaf-curl of the Peach is only too well known in Australia, but the Pear-leaf Blister due to *Exoascus bullacus* is now recorded for the first time, and care should be taken to prevent its spread.

21. Amerosporium rhodospermum, n.sp.

On large discoloured pale patches of still green leaves. Perithecia densely gregarious, black, erumpent, ultimately superficial, disciform or sometimes elongated, ruddy brown by transmitted light, membranaceous and composed of polygonal cells, astomatous, at first bald, soon surrounded at the margin and scattered all over with stiff hairs, 120-160 μ diam.; bristles dark brown, paler at apex and blunt, cylindrical, slightly swollen at base, curved inwardly at margin, thick-walled, continuous or 1-septate, 30-35 × 5-7 μ. Sporules very pale pink, crescent-shaped, acute at both ends or occasionally blunt at one end, continuous, 18-21 × 4-4½ μ.

Killara, Vic.; on living leaves of a flowering specimen of *Diuris pedunculata*, R.Br.; Oct., 1902.

Although this orchid is rather a common one, only a single diseased specimen was found. The lower linear leaves and one of the three upper bract-like leaves were affected. The lower leaves were densely crowded on both surfaces with the black soot-like fungus in patches, while the upper leaf was mainly attacked on the outer surface. The basal leaves ultimately shrivelled up and withered, but the plant otherwise looked as healthy and vigorous as the numerous unaffected specimens growing near.

22. ASCOCHYTA ANTHISTIRIÆ, n.sp.

Perithecia black, erumpent, scattered, elongated, lenticular, depressed, dark brown by transmitted light, membranaceous, with central round pore, 150-175 × 105-115 μ. Sporules numerous, bright olive in mass, pale individually, elliptical, 1-septate, not constricted at septum, rounded at both ends but slightly tapering towards one end, 10-11 × 4-4½ μ.

Leongatha, Vic.; on dry, discoloured, shrivelled portions of living leaves of *Anthistiria australis*, associated with *Sphærella anthistiriæ*, n.sp., of which it is probably the pycnidial stage; Nov., 1902.

This species differs from *A. graminicola*, Sacc., in the larger perithecia and the elliptical, olivaceous spores.

23. ASCOCHYTA CRYPTOSTEMMÆ, n.sp.

Spots irregular, indefinite, dark-coloured, on upper surface of leaves. Perithecia black, punctiform, erumpent, scattered or loosely gregarious, golden-yellow by transmitted light, depressed-globose, membranaceous, fragile, with apical pore, 140-170 μ diam. Sporules hyaline, cylindrical, rounded at both ends, straight, 1-septate, not constricted at septum, 7-10 × 2½-3 μ.

Doncaster, Vic.; on brown withered leaves of *Cryptostemma calendulaceum*, R.Br.; Oct., 1902.

It differs from *A. microspora*, Trail, in the much larger perithecia which are not densely gregarious, and the slightly longer sporules which are always straight and never curved. This species occurred on leaves with *Septoria perforans*, McAlp., which had evidently caused their withering.

24. ASCOCHYTA HYACINTHI, Tassi.

Killara, Vic.; on languishing leaves of *Agapanthus umbellatus*, L'Hérit.; Oct., 1902.

This species evidently agrees with that described and figured by Tassi (Rev. Myc. p. 169, 1896) on *Hyacinthus orientalis*, in Italy, but the brown perithecia are crowded and very erumpent, not embedded as figured.

25. CERCOSPORA LORANTHI, n.sp.

Tufts minute, black, gregarious, seated upon definite, orbicular, raised dark brown spots, which may be confluent, 1-2 mm. in diam., on both surfaces of leaf. Hyphæ straight or slightly flexuous, simple, dark olivaceous, 1- or few septate, 35-40 × 4½-5 μ. Conidia straight or curved, pale olivaceous, rounded at both ends, generally with bulbous or slightly swollen base, 5-8-septate, here and there constricted at septa, variable in length, 60-105 × 4-4½ μ, average 60-80 μ long.

Dandenong Creek, Vic.; on living leaves of *Loranthus pendulus*, Sieber; Nov., 1902 (C. French, Jr.).

The swollen, often confluent, dark brown, raised spots, like pimples on the leaf, are very striking and are crowded with the dark minute tufts, often seemingly merged into one mass.

26. CORYNEUM ACACIÆ, n.sp.

Pustules minute, elevating and rupturing epidermis, on greyish centre of dark brown, orbicular, definitely circumscribed spots, with greenish margin, on both surfaces of phyllode, 1-2 mm. diam. Conidia bright olive, cylindrical, rounded at both ends and sometimes slightly tapering, often towards attached end, usually 5-6-septate, not constricted at septum, straight, or slightly flexuous and curved, generally 49-52 × 5-6 μ, but may only reach a length of 35 μ, on short, hyaline basidia, 3½-4 μ long.

Australian Alps, Vic. (Walter); on phyllodes of *Acacia penninervis*, Sieber.: Werribee, Vic. (Robinson); on phyllodes of *Acacia pycnantha*, Benth.

The characteristic spots with the raised and bursting pustules, the cylindrical septate conidia which may be bent or flexuous, and the very short basidia distinguish this species.

27. CYLINDROSPORIUM EUCALYPTI, n.sp.

Spots definite, grey, generally with distinct raised ruddy brown margin, usually roundish but may be angular or irregular, isolated or confluent, on both surfaces of leaf, ultimately thin, brittle and cracking, very variable in size, from 2-3 mm. to 1 inch in diam. Pustules amphigenous, but more numerous and crowded on upper surface, at first covered by epidermis, then erumpent, globose, dark-coloured. Conidia golden-yellowish in mass, hyaline individually, straight or flexuous, but generally crescent-shaped, acute and tapering at both ends, more gradual at outer end, 3-septate, not constricted at septum, guttulate, 50-56 × 3½-4 μ; basidia very short, hyaline, slender, 8-10 μ long.

Dandenong Creek, Vic.; on young green leaves of *Eucalyptus melliodora*, A. Cunn.; Nov., 1902 (C. French, Jr.).

This is a very distinct species, with its large and definite grey spots dotted with the numerous dark pustules, and the conidia very constantly 3-septate. When the leaf is moistened the conidia have a tendency to ooze out in dirty yellow masses.

28. DIMERIUM ORBICULATUM, n.sp.

Spots numerous, orbicular, sooty black, on upper surface of green leaves, sometimes confluent, 2-3 mm. diam. Mycelium of spots crustaceous, forming a pavement of pale olivaceous, closely adherent and appressed, thin-walled septate filaments, varying in breadth but averaging about 7 μ, surmounted by dark brown, flexuous, labyrinthine, thick-coated septate filaments, about the same thickness but often swollen. Conidia lateral on branches of the brown mycelium, similarly coloured, Puccinia-like and lower cell somewhat tapering towards point of attachment, slightly constricted at septum, 15-17 × 8-9 μ, but varying in size.

Asci clavate, sessile, rounded at free end, 8-spored, 95-105 × 24-28 μ; paraphyses hyaline, slender, branching towards apex, about length of ascus. Sporidia distichous and monostichous towards base, olive, slipper-shaped, 1-septate, unequally celled, upper smaller, rounded at apex, of equal thickness throughout, lower larger, slightly bulging at centre and tapering towards free end, 30-35 × 10-11 μ.

Australian Alps, Vic. (Walter); on living leaves of *Grevillea victoriæ*, F.v.M.

D. orbiculare (B. & C.), Ell. & Ev., on leaves of *Ilex*, has orbicular crustaceous patches, but they are up to 1 cm. diam.; the perithecia are much smaller and amphigenous; and the sporidia are considerably broader.

In Saccardo's 'Sylloge Fungorum' (Vol. xvi.) the genus *Dimerosporium* is divided into two subgenera, according as the sporidia are hyaline or coloured. There is a general convenience in thus distinguishing genera, and while *Dimerosporium*, Fckl., will be reserved for those species with colourless sporidia, *Dimerium*, Sacc. & Syd., will include those with coloured sporidia.

Adopting this classification the seven known Australian species will be arranged as follows:—*Dimerosporium ludwigianum*, Sacc.; *D. parvulum*, Cooke; *Dimerium secedens*, Sacc.; *D. synapheæ*, Henn.; *D. tasmanicum*, Mass.; *D. tarrietiæ*, Cooke & Mass.; *D. orbiculatum*, McAlp.

29. EXOASCUS BULLATUS, Fckl.

Killara, Vic.; on living leaves of Pear-tree; Oct., 1902.

30. GLŒOSPORIUM WALTERI, n.sp.

Pustules gregarious, minute, slightly elevated, becoming black, at first covered by epidermis, finally ruptured, up to 200 μ diam., on both surfaces of leaf but mostly on under, discoloured portion with distinct black margin edged with brown. Conidia hyaline, cylindrical, rounded at both ends or somewhat acute, 21-23 × 4 μ; basidia slender, usually shorter than conidia, about 14-17 μ long.

Buffalo Mountains, Vic. (Walter); on living leaves of *Drimys aromatica*, F.v.M.

The diseased portion of the leaf is a light grey on the upper surface and a pale fawn on the under, so that it is distinctly marked off from the ordinary green portion. The conidia are guttulate in the early stages, and there is a tendency to segregation of the protoplasm as if there was spurious septation. On treatment with Schulze's solution they are stained yellowish and sometimes a deep brown, with marked separation of the protoplasmic contents.

This species differs from *G. magnoliæ*, Passer., in which the conidia are from 8-12 μ long; also from *G. haynaldianum*, Sacc. & Roum., in which they are 12-15 μ long.

I have named this species after Mr. C. Walter, of Melbourne, who found it, and who has contributed a number of other species to the fungus-flora of Australia in the course of his extensive botanical collecting trips.

31. HELMINTHOSPORIUM GRAMINEUM, Rabh.

Killara, Vic.; on leaves and leaf-sheaths of Barley; Sept., 1902.

This fungus has only hitherto been observed in Germany and Sweden. It attacks the lower leaves, causing them to wither and become yellow, although it does not seem to produce great injury otherwise. It does not attack cereals other than Barley.

32. HENDERSONIA GRANDISPORA, n.sp.

Perithecia densely gregarious, immersed, black, dark brown by transmitted light, globose, membranaceous, 120-140 μ diam., forming black expanded indeterminate patches, more particularly on upper surface of leaves. Sporules numerous, smoky-brown, cylindrical, rounded at both ends, straight but generally slightly curved, 3-5-septate, not constricted at septum, with finely granular contents, 50-60 × 5-6 μ.

Wangaratta, Vic.; on leaves of young sapling of *Eucalyptus* sp.; Sept., 1899.

It differs from *H. eucalypti*, Cooke & Hark., in which the perithecia are collected in orbicular spots, and the 3-septate sporules are only 20 μ long.

33. PHOMA ROMULEÆ, n.sp.

Perithecia minute, black, punctiform, gregarious, erumpent, globose, dark brown by transmitted light, membranaceous, firm, of parenchymatous texture, with distinct mouth, 100-112 μ diam. Sporules hyaline, minute, ellipsoid, 4½ × 2-3 μ.

Armadale, Vic.; on leaves of *Romulea bulbocodium*, Sebast.; Aug., 1902.

It differs from *P. iridis*, Cooke, in the perithecia being erumpent, and the sporules much shorter.

This fungus seemed to kill the plant, since the leaves were quite withered except for a small green portion sometimes towards the base, and the plants badly affected had generally lost their hold of the soil. This introduced plant is widely spread around Melbourne, but so far only occasional diseased plants have been met with.

34. PHOMA VITTADINIÆ, n.sp.

Perithecia minute, black, punctiform, erumpent, slightly gregarious, globose, membranaceous, tough, with apical pore, 100-130 μ diam. Spores hyaline, elliptical to oval, minute, 1-guttulate, stained yellowish-green by Schulze's solution, 4-4½ μ long; basidia slender, hyaline, about same length as spore.

Malvern, near Melbourne, Vic.; on dead or dying branches of *Vittadinia australis*, Rich.; Sept., 1902.

It differs from *P. herbarum*, West., in the smaller and shorter spores, and in being only 1-guttulate.

35. SEPTORIA BETÆ, West.

Port Fairy, Vic.; on leaves of *Beta vulgaris*, L.; Aug., 1900.

36. SEPTORIA PERFORANS, n.sp.

Spots on upper surface, dull greyish-brown, orbicular, sometimes confluent, slightly raised, definitely circumscribed, ultimately becoming holes, 5-10 mm. in diam. Perithecia minute, black, punctiform, gregarious, slightly erumpent, globose, membranaceous, of parenchymatous texture, with papillate mouth (24 μ), 80-90 μ diam. Sporules generally slightly curved, sometimes straight, hyaline (stained yellowish by Schulze's solution), 3-septate, acute at both ends, slender, average 28-31 × 2-2½ μ.

Doncaster, Vic.; on living leaves of *Cryptostemma calendulaceum*, R.Br. (Capeweed); Oct., 1902.

This species differs from *S. martinii*, Cooke, found in Victoria on *Bedfordia salicina*, DC. (= *Senecio Bedfordii*, F.v.M.), in the decided greyish-brown spots, and in the 3-septate sporules which are very regularly 28 μ long. The Capeweed known also as "Cape Dandelion," is a native of South Africa, and coming from a climate somewhat similar to our own, has spread rapidly and extensively. But hitherto no fungus has been recorded on it, either here or in its native home, and now this one has been found associated with *Ascochyta cryptostemmae*, McAlp. The specific name has been given on account of the spots affected by the fungus often becoming perforated.

37. SEPTORIA THELYMITRÆ, n.sp.

Spots whitish, surrounded by dark margin, roughly oval, on upper surface of leaf, 2-3 mm. long. Perithecia minute, black, punctiform, erumpent, dark brown by transmitted light, depressed-globose, membranaceous, with minute pore, up to 105 μ diam. Sporules hyaline, rod-like, continuous, straight, very occasionally slightly curved, 2-5-guttulate, 14-16 × 1-2 μ.

Ringwood, Vic.; on languishing, partially brown leaves of *Thelymitra aristata*, Lindl.; Oct., 1902 (C. French, Jr.).

The perithecia and sporules generally agree with those of *S. posekensis*, Sacc., which was found in Siberia on the languishing leaves of an undetermined orchid; but the spots are olive-green and on both surfaces, while in *S. orchidearum*, West., the sporules are 18-22 μ long and 6-8-guttulate.

38. SPHÆRELLA ANTHISTIRIÆ, n.sp.

Perithecia minute, black, punctiform, erumpent, gregarious, generally running lengthwise in lines, globose, membranaceous, with apical pore, on both surfaces of withered portion of leaf but mainly on upper, 100-120 μ diam. Asci oblong to oblong-cylindrical, slightly swollen, then narrowing at base, sessile, without paraphyses, 35-45 × 17-21 μ. Sporidia distichous or conglobate, hyaline, elongate-elliptical, and tapering slightly towards lower end, 1-septate, not constricted at septum, 14-15 × 4-4½ μ (stained yellowish-green by Schulze's solution).

Brighton (Sept., 1902), Leongatha, Vic. (Nov., 1902); on living leaves of *Anthistiria australis*, R.Br.

This species differs from *S. graminicola*, Fckl., in which the asci are larger (75 × 12 μ) and the sporidia are longer (15-20 × 3½-4½ μ). Also from *S. crus-galli*, E. & K., in which the perithecia are differently arranged; the asci are considerably longer and the sporidia, although about the same size, are constricted at the septum.

39. SPHÆRELLA CASSYTHÆ, n.sp.

Perithecia minute, punctiform, scattered, black, dark olivaceous by transmitted light, erumpent, membranaceous, depressed-globose, 70-90 μ diam. Asci clavate to elongate-clavate, often tapering into a more or less slender stalk, 8-spored, 32-37 × 9-12 μ. Sporidia biseriate, hyaline, cylindrical, slightly tapering towards one end, 1-septate, not constricted at septum, guttulate, 9 × 3 μ.

On filiform stems and branches of *Cassytha glabella*, R.Br.

This fungus causes blackening and shrivelling of the parts attacked, and is comparatively rare.

40. UROCYSTIS COLCHICI (Schlecht.), Rabenh.

Near Melbourne, Vic.; on living leaves of *Wurmbea dioica*, F.v.M.; Sept., 1902.

The plant was in flower when the fungus was obtained and it affected the lower leaves badly, while the upper leaves only showed indications of it.

NOTE.—In my previous paper (these Proceedings, 1902, p.377), *Phoma passifloræ* was recorded as a new species on the fruit of *Passiflora edulis*. I find that the name is preoccupied; but *P. passifloræ*, Penz. & Sacc., occurring on the dry flower-stalks of *P. hybrida*, is quite distinct, the sporules only being 7-8 × 3-3½ μ. Owing to the size of the spores I, therefore, propose the name of *Macrophoma passifloræ* for this species.

In my "Descriptions of New Australian Fungi" (these Proceedings, 1896, p. 105), *Phoma stenospora* was recorded on *Notelæa longifolia*, but being on spots on the leaf, as shown in the drawing, it ought, strictly speaking, to be a *Phyllosticta,* and therefore it may be named *Phyllosticta stenospora.*

DESCRIPTIONS OF SOME NEW SPECIES OF WEST AUSTRALIAN PLANTS.

By W. V. Fitzgerald, F.S.Sc., Lond., F.R.H.S., Eng.

(Communicated by J. H. Maiden, F.L.S.)

EPACRIDEÆ.

Leucopogon glaucifolius, sp.nov.

Erect or spreading, usually under 1 foot high, the branches finely hairy. Leaves alternate, linear, rigid, pungent-pointed, convex, with slightly recurved margins or nearly flat, glabrous or scantily tomentose above, finely striate and glaucous beneath, 4-6 lines long. Peduncles all axillary, extremely short, erect or scarcely spreading, mostly 3-flowered and along with the bracts, bracteoles and calyxes finely hairy. Pedicels very short. Bracts minute, mucronate. Bracteoles ovate, prominently mucronate, about ⅓ as long as the calyx. Sepals subulate, about 1½ lines long. Corolla white, about 2¼ lines long, tube slightly ventricose, much shorter than the calyx; segments slightly longer than the tube, revolute with glabrous, acutely pointed tips. Anthers attached above the middle, oblong, rounded at both ends, without sterile tips. Hypogynous disk large, lobes ovate, obtuse, free to the base, ⅔ the length of the ovary. Ovary glabrous, usually 5-celled, but often incompletely 6-8-celled. Style rather stout, of moderate length, with a slightly hirsute capitate stigma. Fruit almost globular, flat-topped, about 1¾ lines long, with 5 broad bicarinate angles or ribs, epicarp yellow, mesocarp slightly pulpy, endocarp not very hard and rather thin.

Loc.—Midland Junction and vicinity; in sandy heathy spots. Flowers and fruit (December, 1902; W. V. Fitzgerald and O. R. P. Andrews).

This species differs from *L. brevicuspis*, Benth., in foliage, and from that species and *L. propinquus*, R.Br., in smaller habit, in the lobes of the hypogynous disk and most essentially in the fruit. Without the fruit it would be readily mistaken for a small form of the latter.

LILIACEÆ.

HENSMANIA, gen.nov.

Flowers hermaphrodite and neuter on the same axis. Perianth shortly persistent, of 6 equal segments, united below the middle into a tubular base. Stamens 3, inserted at the base of the inner segments and not protruding beyond them; filaments flattened; anthers linear, bilobed at the apex, more or less connate, opening along the inner face in longitudinal slits. Ovary 3-celled, with 2 ovules in each cell, on an axile placenta. Style filiform, entire, with a minute stigma. Fruit capsular, 3-celled, dehiscing loculicidally into 3 valves. Seeds 2 in each cell, uppermost erect, lowest pendulous, funicle thickened into a prominent strophiole; testa crustaceous, shining black.

A tufted perennial, with terete leaves and simple bracteate scapes. Flowers in white woolly turbinate heads, the inflorescence surrounded by an involucre of loosely imbricated bracts.

Technically the structure of the flower is similar to that of *Johnsonia*, R.Br., but the bracteate scapes, the white woolly turbinate heads, and the fact that only the outer flowers develop fruit seem to afford sufficient grounds for establishing this new genus. It may be observed that it is established on perfect flowering specimens of *Xerotes turbinata*, Endl. Apparently perfect flowers were not known to that botanist, yet, as he evidently saw the fruit, it is strange that no comments were made on its remarkable structural divergence from that of the true *Xerotes*. Bentham did not see specimens in flower or fruit. The abortive ovary referred to by that authority evidently belonged to a neuter flower. Although I have numerous examples before me I have failed to find any trace of the spreading stigmatic lobes referred to by him.

H. TURBINATA.

Xerotes turbinata, Endl., Pl. Preiss. ii. 51; Benth., Fl. Aust. vii 107.

Forming tufts 6 inches or more across. Leaves rigid, striate, terete, tapering into an almost pungent point, straight or slightly twisted, 6-12 inches long, the outer ones reduced to numerous sheathing scales with scarious woolly-ciliate margins, when old splitting into numerous filaments. Scapes rather stout, bracteate from above the middle, 1-2½ inches high, with a turbinate or ovoid head of flowers attaining with the bracts a diameter of ½-¾ inch. Bracts loosely imbricated, ultimately forming an involucre round the head, the lowest about 1 inch long, the others varying to ¼ inch, brown, lanceolate-acute, with scarious woolly-ciliate margins. Flowers pale yellow, several within each head, on filiform pedicels of ¼-½ line long, the outer (hermaphrodite) ones subtended by a small scarious bract, the whole surrounded by white woolly hairs almost concealing the flower, the inner (neuter) ebracteate, the subtending hairs numerous. Perianth about 2 lines long, divided ⅔ of its length into 6 subulate nerveless segments, the inner broader than the outer; tube narrow-turbinate. Filaments extremely short. Capsule pale green, smooth or slightly transversely streaked, trigonous-ovate, acute, 2 lines long, readily dehiscent. Seeds ovate, about ½ line long.

Loc.—Swan River District; in sandy or heathy spots, flowering during December (Drummond, Preiss, and others).

AMARYLLIDEÆ.

CONOSTYLIS HARPERIANA, sp.nov.

Stems short, densely tufted. Leaves not distichous, with short sheathing bases, glabrous, striate, rigid, with entire or finely serrulate margins, 1½ lines broad, mostly under a foot in length. Scapes, including the inflorescence, 12-15 inches long, slightly tomentose, bearing 2-3 thin lanceolate-acuminate bracts of 1-1½ inches long. Flowers golden yellow, numerous, in loosely branched bifurcated cymes, with usually a single pedicellate flower or small cyme lower down. Pedicels ½ line long, subtended by linear scarious bracts of 4-6 lines long. Perianth infundibuliform, 4-5 lines long, plumose-tomentose outside, almost or quite glabrous within. Segments lanceolate-linear, slightly longer than the free part of tube. Anthers oblong, on equal, extremely short, flattened filaments. *Placentas shortly stipitate, covered all over with* numerous ovules; styles stout, conspicuously hooked at the end. Ripe fruit not seen.

Loc.—Near the margin of a lagoon 6-7 miles N.E. of Bayswater (W. V. Fitzgerald; November, 1902).

This pretty species usually forms tufts of one foot or more across and bears a close relation to *C. cymosa*, F.v.M., differing in the scapes always longer than the leaves, in scantiness of tomentum, and in the proportionate length of the perianth-segments. Not only has this species a peculiar inflorescence, but the hooked style seems to be exceptional for the genus.

I have dedicated the species to Hon. C. Harper, M.L.C., of Woodbridge, W.A., a gentleman who, in years gone by, did a great deal towards elucidating our native flora.

CENTROLEPIDEÆ.

CENTROLEPIS INCONSPICUA, sp.nov.

Minute, slightly tufted and glabrous. Scapes almost none within a few erect, linear, somewhat flaccid leaves of 1-1½ inches long, with very broad, scarious, sheathing bases, the inner ones not reduced. Floral bracts close together, ovate, glabrous, erect, 2 lines long, with membranous margins, terminating in leaf-like awns of ¾-1½ inches long, the lowest the longest. Flowers in each bract 2, intermixed with rather numerous, prominent, unequal, broad-linear chaffy scales, obtuse, acute or occasionally the shorter ones slightly jagged, one by the side of each ovary and one under each stamen, with several others adjacent. Carpels of the ovary apparently constantly 2.

Loc.—Pinjarrah; in wet spots (W. V. Fitzgerald; October, 1900).

Differs from *C. aristata*, Rœm. et Schult., principally in the leaves and fewer parts to the flower. In foliage and habit it approximates to *C. humillima*, F.v.M.

RESTIACEÆ.

RESTIO STENOSTACHYUS, sp.nov.

Rhizome rather stout, creeping, enveloped in reddish wool. Stems slender, erect or flexuose, simple or with few branches, terete, sulcate, glabrous, 1-2 feet high. Sheathing scales closely appressed, pale brown, mucronate, with tufts of reddish wool in the axis. Floral bract similar, closely embracing the base of the spikelet. Spikelets in both sexes of a reddish colour, solitary and terminating the branches, or with 1-2 axillary lower down, from narrow-ovate and 2 lines to cylindrical and ¾ inch or more in length. Flowers numerous within each spikelet. Male spikelet with 2 empty glumes, lanceolate-ovate, tapering into acute rigid points, ciliate on the bracts and margins with woolly hairs; flowering glumes similar. Perianth very flat, segments 6, 2 outer ones lanceolar, complicate, ciliate on the back with reddish wool, 4 inner ones flat and almost hyaline. Anthers red, much exserted. Rudimentary ovary minute.

Female spikelets with glumes rather broader than in the males, with white, scarious, ciliate margins, a little reddish wool on the back, 3 outer empty ones. Perianth similar to the male. Staminodia minute or none. Ovary flat, 2-celled; styles slightly connate at the base, nearly as long as the ovary and much exserted, stigmatic in the upper half. Ripe capsule not seen.

Loc.—Burswood; in wet spots (♀; in March, 1900); near Causeway, Perth (♂; April, 1901; W. V. Fitzgerald).

In habit and inflorescence approximates to *R. deformis*, R.Br., but differs materially in the vestiture and the structure of the spikelet.

HYPOLÆNA FASCICULATA, sp.nov.

Rhizome tufted, slightly woolly. Stems pubescent with white spreading hairs, rarely glabrous, under 18 inches high; branches numerous, flexuose, slender, in irregular fascicles. Sheathing scales broad, appressed, produced into linear laminæ of 3-6 lines. Male spikelets solitary, terminating numerous fascicled branchlets, the subulate bracts continuous, broadly ovoid, 2 lines long, with numerous flowers. Glumes broad, brown with slightly scarious margins, shortly aristate, a few outer ones short and empty. Perianth-segments 6, narrow hyaline, obtuse, the 2 outer ones slightly complicate and longer than the others. Anthers on long filaments. Female spikelets not numerous, sessile, solitary and terminal, the subtending bract continuous or 2, the second sessile lower down, narrow-acuminate, 3 lines long. Glumes 5, the 2 outer ones foliaceous, short, terminating in linear points; 3 inner ones rather long, ovate-lanceolate, acute, brown and slightly hairy on the backs. Perianth-segments 6, thin, hyaline, broad, notched at the top, shorter than the ovary. Style long, divided to the middle into 3 filiform branches stigmatic almost to the base. Nut pale-coloured, ovoid, very hard, nearly 1 line long, on a thick receptacle.

Loc.—Canning Plains (♂♀; 1st January, 1903; W. V. Fitzgerald).

Closely allied to but apparently distinct from *H. fastigiata*, R.Br.

CYPERACEÆ.

CYATHOCHÆTE TERETIFOLIA, sp.nov.

Rhizome tufted. Stems very rigid, attaining a height of 4 feet, terete below the inflorescence, striate, with a sheathing bract at or above the middle, ending in a long leaf-like lamina. Leaves terete or slightly compressed, not numerous, nearly as wide as the stems, quite erect, tapering into long slender points; sheaths crowned at the summit with a small membranous margin. Panicle very long and narrow, with numerous long, erect branches, several together in each bract. Lower floral bracts with long partially open sheaths, with a hyaline margin at the orifice and ending in long, linear, flattened laminæ, the upper ones becoming gradually abbreviated. Spikelets few on each peduncle, nearly 1 inch long, pale-coloured, linear-lanceolate, acuminate. Glumes 4, not distichous, all aristate, the 2 outer empty ones shorter. Hypogynous bristles in the hermaphrodite flower rather long, ciliate at the end, absent from the lower barren flower. Stamens 2, and style with two slender branches, much longer than the glume. Ripe fruit not seen.

Loc. — Bayswater; in swamps (December, 1901; W. V. Fitzgerald).

Closely allied to *C. arenacea*, Benth., differing in larger habit and inflorescence and in the terete foliage.

SCHŒNUS CÆSPITITIUS, sp.nov.

Rhizome tufted. Stems 1-2 feet high, slender, erect, rush-like, rigid, finely striate, leafless excepting the dark brown leaf-sheaths at the base. Leaf-sheaths rather closely appressed, hastellate at the orifice with spreading white hairs, the inner ones terminating in semiterete, rigid, often flexuose laminæ of 1-3 inches. Panicle terminal, usually turned to one side, 1-2½ inches long. Lower floral bracts similar to the inner basal sheaths, the upper gradually shorter. Spikelets in clusters of 2-4, mostly 3, on nearly equal pedicels, of 1-3 lines long, spreading, lanceolate-acuminate, dark brown, slightly compressed, about 6 lines long, containing 3 flowers, the lowest abortive, the 2nd maturing fruit, the upper usually diseased and forming a globular white-woolly mass. Glumes lanceolate-ovate, strongly keeled, margins ciliate with white-woolly hairs, 6-8 outer empty ones gradually shorter, the lower 2 minute. Hypogynous bristles unequal, acute, shorter than the nut. Stamens 3. Nut brown, narrow-ovate, trigonous, finely muricate, ¾ line long.

Loc.—Serpentine (September, 1901), near Perth (October, 1902; W. V. Fitzgerald); Torbay Inlet (December, 1902; H. Sheath).

The species bears some resemblance to *S. fascicularis*, Nees, but differs in the larger habit and in the spiklets and nut. The hastellate leaf-sheaths and presence of hypogynous bristles removes it from *S. brevifolius*, R.Br. It has a close affinity to

S. melanostachyus, R.Br., but differs in the more numerous empty glumes, in the lowest flower not perfecting fruit, and in the nut.

SCHŒNUS LÆVIGATUS, sp.nov.

Rhizome shortly creeping. Stems glabrous, erect, straight or slightly flexuose, faintly striate, rigid, 1-1½ feet high, leafless excepting the numerous shining dark brown sheaths at the base and often one at or above the middle. Inner basal and stem-sheath with a membranous margin and terminating in a subulate compressed lamina of 4-6 lines long. Panicle rather loose but narrow, 1½-3 inches long, with sometimes a small cluster from the stem-sheath. Lower floral bracts similar to the sheaths, the upper gradually smaller. Spikelets in each bract in clusters of 2-5 (usually 4) on very unequal slender pedicels of 1-2 inches long, erect, ovate-lanceolate, brown, 4-5 lines long, compressed, containing 2 flowers, both fertile. Glumes acute, 3-5 empty outer ones gradually shorter, all slightly woolly-ciliate near the apex. Hypogynous bristles 6 or fewer, ciliate, unequal, 3 often much longer than the nut. Stamens 3. Nut dark brown, ovate, obtusely trigonous, rugose, ¾ line long.

Loc.—Bayswater (November, 1901; W. V. Fitzgerald).

Approximates to *S. brevifolius*, R.Br., differing principally in the bracteate stem, smaller spikelets with fewer flowers, and in the presence of hypogynous bristles. It differs already from *S. pedicellatus*, Benth., and *S. fascicularis*, Nees, in the membranous margined and not bearded sheaths.

SCHŒNUS LAXUS, sp.nov.

Rhizome tufted. Stems glabrous, erect, terete or slightly compressed, slender, faintly striate, 1½-2 feet high. Leaves basal, few, almost subulate, with dark-coloured hooked points, 1½-3 inches long; sheaths pale brown, slightly appressed, the innermost 2-2½ inches long, the orifices barbellate with long hairs. Panicle very loose, the spikelets on slender pedicels of 2-2½ inches, forming clusters in the axils of dark brown sheathing bracts which often terminate in subulate hooked laminæ of 1 inch.

Spikelets lanceolate, acute, compressed, 3-3½ lines long, 2-flowered, the upper maturing fruit. Glumes acute, with a prominent black dark brown keel, the brown membranous margins scantily ciliate, 4-5 outer empty ones gradually shorter. Hypogynous bristles very unequal, 2 about ⅓ as long as the nut, acuminate, slightly ciliate. Stamens 3. Nut whitish, obovate, obtusely trigonous, almost stipitate, minutely granular, ½ line long.

Loc.—Near Torbay Inlet (December, 1902; H. Sheath).

This species is allied to *S. indutus*, F.v.M., differing principally in the stems being constantly glabrous, in the bearded orifices to the leaf-sheaths, and in the upper flower alone developing fruit. Externally the spikelet bears a close resemblance to that of *S. Rodwayanus*, W. V. Fitzg., but the structure and nut are very different.

SCHŒNUS ANDREWSII, sp.nov.

Rhizome tufted. Stems rigid, erect, terete, deeply striate, resinous-scabrous, 1-1½ feet high, leafless except several loose sheathing bracts at the base, 1 or 2 inner ones rather long, brown or almost hyaline and terminating in subulate, striate, slightly resinous laminæ of 1-2 inches, lower sheaths dark brown and shining, the orifice glabrous or slightly ciliate. Panicle very narrow, 1½-2 inches long. Floral bracts shortly sheathing, the lower one ending in a leaf-like lamina sometimes longer than the inflorescence. Spikelets 1-2 in each bract, the second one always shortly pedicellate, pale brown, ovate-lanceolate, slightly resinous, 3½ lines long, with 2 flowers, the second maturing fruit. Glumes mucronate, slightly ciliate, 2-3 outer empty ones. Hypogynous bristles small, ciliate. Stamens 3. Style with 3 plumose stigmatic lobes. Nut brown, narrow-ovate, trigonous, tuberculate, nearly 1 line long, shortly stipitate and crowned by the hardened base of the style.

Loc.—Cannington; in heathy or sandy spots (C. R. P. Andrews, young flowers, November, 1902: W. V. Fitzgerald, flower and fruit, January, 1903).

Apparently this species has no immediate ally. The nut is quite that of *Elynanthus*. In the proximity of the flowers and in the upper flower only maturing fruit it agrees with *Tricostularia*. All the other characters are those of true *Schœnus*. The resinous-scabrous character of the species serves to distinguish it at a glance from all others.

Named after the original discoverer, Mr. C. R. P. Andrews, Principal of the Training College, Claremont, W.A.

The following species have not hitherto been recorded from Western Australia:—

CHENOPODIACEÆ.

ANISACANTHA (BASSIA) LONGICUSPIS, F.v.M.

Kalgoorlie (W. V. Fitzgerald; August, 1898).

GRAMINEÆ.

STIPA TUCKERI, F.v.M.

Credo Mine, between Broad Arrow and Black Flag (W. V. Fitzgerald; September, 1898).

THE BACTERIAL ORIGIN OF THE GUMS OF THE ARABIN GROUP.

BY R. GREIG SMITH, D.SC., MACLEAY BACTERIOLOGIST TO THE SOCIETY.

III.—THE ACIDS PRODUCED DURING THE GROWTH OF *BACT. ACACIÆ* AND *BACT. METARABINUM* IN SACCHAROSE MEDIA.

The two bacteria are grouped together because it became evident as the research proceeded that they produce identical acids. The preliminary tests, which were made with the view of obtaining a general idea of the nature of the acids so that a particular scheme might be adopted or devised, were made upon material which had been formed in chalk solutions of saccharose-potato extract. These solutions contained .5 % of chalk and 5 % of saccharose. Saccharose-potato extract had, in conjunction with agar and tannin, proved an excellent medium for the formation of gum, and on this account it was used pending the determination of the essential nutrients contained in it.

Flasks containing the media were infected with the bacteria and incubated for a month at 30°. At the end of this time, the cultures were evaporated, cooled, and treated with an excess of dilute sulphuric acid. There were thus obtained solutions of the bacterial acids and residues of calcium sulphate. The former were extracted with ether in the apparatus of Schoorl,* and the latter, after being dried in the air, were transferred to paper cartridges and extracted by ether diffusion in the same apparatus. After treatment with ether the respective extracts were distilled to eliminate the ether and the residual fluids were examined.

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* Journ. Soc. Chem. Ind. xix., 567.

The residue from the solution of the acid fluid was diluted with water when there separated out a small quantity of fat. This was not examined, partly on account of its small amount, and partly because a former experience had shown that the water insoluble fatty acids are found chiefly in the calcium sulphate residue. The filtered solution was distilled with steam until the distillate had but a faint acidity. The distillate, which had a fruity odour, was boiled with an excess of barium hydrate. What appeared to be common alcohol was detected as it rose in the aërial condenser attached to the flask in which the distillate was boiled. After boiling for two hours the solution was cooled, acidified with sulphuric acid and distilled. The distillate, which gave a very faint precipitate with mercuric chloride, was neutralised with baryta water and evaporated to dryness. The analysis of the residue, dried at 140°, gave the following figures:—

0·1444 grm. gave 0·1313 grm. $BaSO_4$ = 53·48 % Ba.
Barium acetate contains ... ... 53·73 % Ba.

During the analysis, the odour of acetic acid was given off upon the addition of the sulphuric acid to the barium salt.

The non-volatile acids were evaporated nearly to dryness, and allowed to crystallise overnight. Colourless prisms separated out. These could be sublimed and melted at 180°, thus indicating succinic acid.

After removing the crystals the mother liquor was diluted and a portion treated with calcium acetate. No precipitate formed at once, but on warming crystals slowly separated. When examined microscopically, after twenty-four hours, the crystals were seen to consist of tufts of needles with a few octahedra and lens-shaped forms. Both from the macroscopic and the microscopic observations the precipitate appeared to be calcium citrate with a trace of calcium oxalate. A solution of citric acid was treated with calcium acetate and used to confirm the method of precipitation and microscopical examination.

The filtrate from the calcium citrate was treated with an excess of milk of lime and filtered. The residue obtained on evaporating the filtrate to dryness was extracted with hot 70 % alcohol and filtered. The filtrate, after standing overnight, had deposited mammillated crusts of what appeared to be calcium lactate. These were washed with cold alcohol and ether and finally dried at 100°. In the dry crystals the calcium was estimated :—

0·2740 grm. gave 0·1284 grm. $CaCO_3$ = 18·75 % Ca.
Calcium lactate contains ... ... 18·27 % Ca.

Another portion of the fixed acids, after separating the crystals of succinic acid, was boiled with an excess of baryta water, and neutralised with sulphuric acid. The barium sulphate was removed, and the clear filtrate treated with ammonia and three volumes of alcohol. The precipitate, when dried at 140°,* gave the following analysis:—

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* The barium salt was dried at 100° until it ceased to lose weight. On increasing the temperature to 140° a further loss of weight occurred. As the drying temperature would influence the analysis of the salt, a small quantity of succinic acid, which was one of the acids present in the solution, was neutralised with baryta water, and precipitated with alcohol, filtered, and dried at 100° and 140°. The following results were obtained :—

0·1 grm. succinic acid gave 0·2102 grm. barium succinate dried at 100°, and 0·206 2grm. dried at 140°.
The barium sulphate therefrom weighed 0·1874 grm.
Ba % at 100° = 52·43; at 140° = 53·44.
Ba in $BaC_4H_4O_4$ (theoretical) 54·16 %.
98·04 % of the succinic acid was recovered.

Citric acid was converted into the barium salt, and the following numbers were obtained :—

0·1 grm. crystallised citric acid gave 0·1840 grm. barium citrate at 100°, and 0·1740 grm. at 140°.
The barium sulphate therefrom weighed 0·1523 grm.
Ba % at 100° = 48·67; at 140° = 51·47.
Ba in $Ba_3(C_6H_5O_7)_2$ = 52·11 %.
98·53 % of the citric acid was recovered.

From these results it is evident that the barium salts must be dried at a temperature over 100°.

0·5962 grm. gave 0·5346 grm. $BaSO_4$ = 52·62 % Ba.
Barium citrate contains ... ... 52·11 % Ba.
Barium succinate contains ... ... 54·16 % Ba.

In view of my percentage figures being generally low, it would appear that the salt is a mixture of barium citrate and succinate.

The solution obtained after distilling the ethereal extract of the calcium sulphate residue was diluted with water when a brown insoluble fatty acid separated. This was collected, dried, transferred to a small filter, treated with ether, and the ether evaporated. The residual fatty acid, which was solid at the ordinary temperature, melted at 40-43°, from which it appeared to be lauric acid.

The mother liquor was boiled with an excess of baryta water, neutralised with sulphuric acid, filtered, and evaporated down to small volume. A salt separated out, and an analysis showed that it contained 51·94 % Ba, from which it appeared to be barium citrate.

The filtrate from the barium citrate was treated with an excess of sulphuric acid and distilled in a current of steam. No volatile acids passed over. The acid solution was extracted with ether, and the residual acids allowed to crystallise. Colourless prisms imbedded in lauric acid were obtained. The prisms were partly purified by drying them on filter paper at 100°; the fatty acid being absorbed by the paper. The crystals were sublimed and a determination of the melting point of the sublimate was made. The sublimate had the same microscopical appearance and melting point as sublimed succinic acid. It softened at 175°, and melted completely at 180°.

From these preliminary results it appears that the acids contained in cultures of the bacteria made in potato extract in the presence of chalk and saccharose consist of acetic, lauric, citric, lactic and succinic, with traces of formic and oxalic.

Since these acids were found in the potato extract cultures it is probable that in other and more definite media there would be a smaller number, because the acids normally present in the extract are undoubtedly included. As the chief nitrogenous nutrient of the boiled potato extract is asparagine, I determined to employ it in media for the confirmatory tests. Accordingly, solutions containing saccharose, 50 grm.; asparagine, 3 grm.; potassinm phosphate, 2 grm.; potassium chloride, 5 grm.; chalk, 10 grm. and tap-water 1000 c.c. were, after sterilisation, infected with the bacteria and allowed to stand in a cupboard at the ordinary room temperature for three weeks. In the culture of *Bact. acaciæ* the chalk granules, on shaking the flask, floated about loosely in the fluid, while with *Bact. metarabinum* the chalk and slime cohered together in one mass.

The culture of *Bact. acaciæ* was boiled under an inverted condenser with 4 grm. of barium hydroxide for two hours. The filtrate from the sediment was then distilled in a partial vacuum until one-third had passed over. The distillate was again distilled until one-third had distilled. The process was continued until about 10 c.c. of distillate were obtained. This had a smell of ammonia, which was removed by distilling with a few drops of phosphoric acid. Ultimately one c.c. of a fluid which showed the alcoholic tear-drops and boiled at 80° was obtained. From this a few drops of a liquid which boiled at 78° were obtained by distilling with anhydrous sodium carbonate. The liquid burned with a blue flame, and had the odour of ordinary ethyl alcohol. The residues obtained during the distillation gave the iodoform reaction with the characteristic microscopical appearance of iodoform.

The culture of *Bact. metarabinum* was heated on the steam bath with barium hydroxide as the viscous nature of the solution negatived any suggestion of boiling. Otherwise the process was a repetition of that to which the culture of *Bact. acaciæ* had been subjected, and as with *Bact. acaciæ* the culture of *Bact. metarabinum* yielded a few drops of ethyl alcohol.

The residual liquid from the first alcoholic distillation was evaporated down nearly to dryness, and when cold added to the barium-calcium carbonate sediment which had meanwhile been treated with an excess of dilute sulphuric acid. After standing over-night the supernatant liquid was filtered and the residue washed with small quantities of water. Finally the residue was dried in the air and reserved for ether diffusion.

The filtrate, which had the odour of vinegar, was distilled in a current of steam, but as hydrochloric acid was found in the distillate the latter was returned to the original liquid and the whole was extracted by percolation with ether for twelve hours. Since hydrochloric acid had been found in the steam distillate of *Bact. acaciæ*, the distillation was not attempted with *Bact. metarabinum.* The ether was distilled off and the residual fluid reserved.

The barium-calcium sulphate residue, after drying in the air, was powdered and put into a filter paper cartridge and extracted by diffusion with ether. The ether was distilled off and water added to the residual fluid when an oil separated out. This was removed, dried, and the melting-point determined by the capillary tube method. In the tube the solidified fatty acid, which appeared microscopically as tufts of silky needles, rose at 43° and became clear at 45°. As the rising in the capillary tube is taken as the melting point of fats, the identity of this acid with lauric acid (m.p. 43·6°) may be assumed. The quantity was too small to warrant testing it by other means.

The mother liquor from the lauric acid was added to the solution of the acids obtained by the ethereal percolation of the acid solution, and the whole was distilled in a current of steam until a faintly acid distillate was obtained. Half of the distillate was neutralised with sodium hydrate, evaporated down to small bulk, and treated with silver nitrate. The white precipitate was quickly filtered and washed, then dried, first on porcelain, and finally over sulphuric acid *in vacuo.* When the salt ceased to lose weight an estimation of the silver was made.

0·2044 grm. gave 0·1354 grm. Ag = 66·25 % Ag.

Silver acetate contains ... ... 67·08 % Ag.

The chief volatile acid was therefore acetic. The filtrate from the silver acetate rapidly darkened, showing the presence of formic acid. This was also shown by the decided formation of calomel on boiling the distillate with mercuric chloride.

The remaining solution of the volatile acids was evaporated to dryness after the addition of an excess of calcium carbonate. The dry residue was extracted with strong alcohol, and a portion of the solution tested with zinc nitrate; no precipitate of zinc valerate was formed. The remainder of the alcoholic solution was evaporated to dryness and the small residue was found to be insoluble in strong alcohol, and on the addition of dilute sulphuric acid, evolved the odour of acetic acid. Thus the only volatile acids that are formed by the bacteria are acetic and formic.

The non-volatile acids which had been set aside to crystallise produced colourless prisms that melted at 180°. They could be sublimed and a neutral solution formed a pale buff precipitate with ferric chloride. The crystals, therefore, were succinic acid.

Calcium acetate was added to the mother liquor and a slight precipitate was deposited in twenty-four hours. The precipitate consisted of microscopic octahedra of calcium oxalate.

The filtered solution was warmed, then placed in the water-bath, but no precipitate of calcium citrate could be obtained. Half of the solution was neutralised with milk of lime and returned to the remainder, but still no precipitation could be induced. Evidently citric acid is not a by-product of the bacteria, and in the preliminary experiments this acid must have been derived from the potato extract.

The solution was treated with an excess of milk of lime and filtered. The filtrate, after evaporation to dryness, was extracted with hot 70 % alcohol. The slight residue, insoluble in the alcohol, consisted of carbonate and succinate of calcium. Mammillated crystals of calcium lactate separated out from the alcohol on cooling, and the quantity showed that lactic acid* was the chief constituent of the non-volatile acids. The lactate was recrystallised from alcohol (calcium succinate being found as an impurity) and an analysis made of the salt.

0·4965 grm. gave 0·2245 grm. $CaCO_3$ = 18 09 % Ca.
Calcium lactate contains .... 18·35 % Ca.

The purified salt from *Bact. metarabinum* was found to be dextro-rotatory, indicating that the acid contained laevolactic acid. The zinc salt of the acid produced by *Bact. acaciæ* was prepared and re-crystallised. It contained 13·1 % of water of crystallisation driven off at 140° C. As optically inactive lactate of zinc contains 3 molecules of water of crystallisation, equal to 18·18 %, and the active salt 2 molecules, equal to 12·9 %; it is evident that the acid consists chiefly of an active acid. The specific rotation of the hydrated zinc salt was found to be $[\alpha_D] = +5{\cdot}58°$, and of the acid to be $[\alpha_D] = -3{\cdot}69°$. According to Schardinger the specific rotation of laevolactic acid is $-4{\cdot}3°$, and according to Purdie the pure hydrated zinc salt of laevolactic acid has a rotation $[\alpha_D] = +6{\cdot}81°$. The lactic acid formed by *Bact. acaciæ* therefore consists chiefly of laevolactic acid, and this undoubtedly also holds for *Bact. metarabinum*.

The mother liquor from the calcium lactate was evaporated almost to dryness and treated with strong alcohol. Crystals separated from the alcohol. These gave no odour of acetic acid on treatment with sulphuric acid. The analysis showed the following figures:—

0·0912 grm. gave 0·0542 grm. $CaCO_3$ = 23·78 % Ca.
Calcium aspartate contains ... ... 23·13 % Ca.

The precipitate was probably the calcium salt of aspartic acid, doubtless derived from the residual asparagine upon boiling the culture medium with barium hydroxide.

The method which was employed in the separation of the non-volatile acids is practically that of Schoorl; in the preliminary experiments it had been found to be most satisfactory. Malic acid could not be detected in the cultures.

The acids in the culture of *Bact. metarabinum* were identical with those obtained from *Bact. acaciæ*, with one exception. In place of lauric acid a mixture of a solid acid and another, fluid at the laboratory temperature, was obtained. This was peculiar because in the preliminary test the insoluble fatty acid was lauric and identical with that yielded by *Bact. acaciæ*. The quantity was, however, too small to separate the constituents.

During the fermentation of saccharose, carbon dioxide is evolved. This was proved by connecting flasks of baryta water with small cultures of the organisms in saccharose-potato extract. The usual precautions were adopted to seal the air inlet and trap the air outlet with a tube containing soda-lime. Upon drawing the air in the culture flask through the baryta water, barium carbonate was formed.

To gain some idea as to the relative quantities of volatile and non-volatile acids, a test was made with the acids obtained after extracting the sulphuric acid solution and the calcium sulphate residue of *Bact. metarabinum* with ether. These were added together, after filtering off the insoluble fatty acid, and distilled in a current of steam until the distillate had but a faint acidity. The non-volatile acids were maintained at 50 c.c. and the distillate measured 600 c.c. The volatile acids required 19 c.c., and the non-volatile acids required 59 c.c. of normal soda for neutralisation. The proportion is therefore, roughly, three parts of non-volatile to one of volatile acids.

In summarising these results it is seen that the acids formed by the action of *Bact. acaciæ* and *Bact. metarabinum* upon saccharose, with asparagine as a nitrogenous nutrient, consist of about three parts of non-volatile and one part of volatile acids. The former consist of laevolactic, chiefly, with a smaller quantity of succinic, of lauric and traces of oxalic. The volatile acids consist of acetic, chiefly, with a smaller quantity of formic and carbon dioxide. Ethyl alcohol is also formed during the fermentation.

IV.—THE GUM-FLUX OF THE VINE.

The disease of the vine which is known by the name of "gummosis" or "mal nero," is characterised by the stems becoming stunted, the young branches do not develop normally, and the green leaves become deformed. Cross sections of the stem show the wood speckled with black in the earlier stages of the disease, and in the later stages the whole section is of a dark brown colour. The disease begins at the growing points, generally at a wound, and spreads downwards. The microscopical examination of the wood shows the vessels, and especially the wood parenchyma, filled with a brown gum imbedded in which are myriads of bacteria.*

So far as I can learn, this disease is not found in Australia, but a gum-flux does occur. This is not a disease like gummosis, as the health of the plant is not appreciably affected. The gum exudes generally from the surfaces of the branches which have been cut by the pruning knife, and the vines which produce the gum are found in rather damp situations.

In response to my enquiries, Mr. Fred. Stoward, of Adelaide, S.A., forwarded several portions of vine stems with gum upon the pruned ends. The plants from which the portions were taken had been growing upon a low-lying, rather damp flat. The plants were not unhealthy, and the vigneron could not distinguish the vines which bore the gum from those in the same locality which yielded none. The sections of the branches had a normal healthy appearance. I also received a small quantity of dry gum which had been picked from the stems.

The gum consisted of small broken fragments, varying in colour from white to black. They were very dry and brittle, and broke with a glistening fracture. When covered with water the fragments swelled greatly, and the black colour was replaced by a brownish tinge. The gum softened and dissolved in water with extreme slowness. In this connection it must be borne in mind that the gum was collected in November and had been taken from wounds made by the pruning knife in the previous season. The gum had therefore been subjected to many months' rain, which would probably have washed away any soluble gum that might have been present originally. On boiling with 5 % sulphuric acid the gum acids were hydrolysed and were found to consist of arabinose and galactose, which showed that the gum was of the arabinan-galactan kind.

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* Cent. für Bakt. 2te Abt. i. 300.

On cutting across a portion of the branch at the end of which gum was adhering, minute clear droplets issued from the cut ends of the large vessels of the wood. The droplets were, however, found to be sterile, and doubtless consisted of sap.

The transverse sections of the twigs and branches which had been sterilised on the outside by flaming, were inserted into nutrient glucose gelatine and incubated for from one to three hours at 30°. The infected media were subsequently poured into Petri-dishes and incubated at 22° for several days. Many colonies of bacteria developed upon the plates, and among them I identified *Bact. acaciæ* and *Bac. levaniformans*, both of which, as I have already shown, produce gum. The other bacteria could not be induced to form gum by the methods which had been successful in other cases, and it is probable that they were not gum-producing bacteria. I always purify the bacteria from the original colonies when they promise to be important, and in purifying one or two races of *Bact. acaciæ* I found *Bact. metarabinum.*

In the presence of *Bact. acaciæ*, *Bact. metarabinum* is not easy to separate. The deep colonies of both bacteria are very much alike, and the sub-surface colonies of *Bact. metarabinum* do not break through to the surface to form a slime-drop colony like *Bact. acaciæ.* It is only when the colony of *Bact. metarabinum* is actually on the surface that it can be recognised with certainty, and as there are comparatively few in original plate cultures, it is not surprising that *Bact. acaciæ* can be readily isolated and *Bact. metarabinum* can be easily ignored. In the original separation of *Bact. metarabinum* from *Acacia penninervis*, the bacterium had been picked out of the plates as being a sub-surface colony of *Bact. acaciæ*, and in the present instance its colonies had not been observed upon the original plates. The occurrence of *Bact. metarabinum* as an impurity in the original colonies of *Bact. acaciæ* is a point to be remembered when the organism is not found in the original plates.

With regard to the presence of *Bac. levaniformans* in the plant, it is probable that it is not responsible for the production of any constituent of the gum. The gum levan which it produces from saccharose is readily hydrolysed in acid fluids, and would be hydrolysed by the acid juices of the plant as soon as it was formed. For this reason the presence of the organism may be looked upon as accidental. The secretion of invertase by this bacillus, however, must not be forgotten, and possibly the invertase may assist the other bacteria to form the gum.

The races of *Bact. acaciæ* and *Bact. metarabinum* were identical with those already described. Quantities of the gum were prepared by growing the bacteria upon saccharose-potato-tannin agar and subsequently obtaining the gum from the slime.* From the characters of the gum-acids as regards solubility and the formation of arabinose and galactose on hydrolysis, there was no doubt of the identity of the bacteria.

Summary.—The investigation showed that the gum-flux of the vine is caused by *Bact. acaciæ* and *Bact. metarabinum.*

V.—The Gum-flux of the Plum.

Among the Rosaceæ the plum frequently exudes gum from punctures and wounds on the stem and branches, and, like the gum from the other members of the family, plum gum is recognised as belonging to the arabin group.

I received specimens of wood and bark with adhering tears and globules of a pale straw to reddish-coloured gum from Mr. Cheel, who had obtained the specimens from the Crawford River district, about six miles from Bullahdelah. Unfortunately, the specimens as I received them were rather dry, a fortnight having elapsed since they had been removed from the tree. The gum masses, however, were large, and while the outer layers were leathery the inner portions in contact with the bark were soft and probably contained living bacteria.

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* The potato-extract used in the preparation of the agar was originally made by adding an equal volume of water to the juice of old potatoes. With new or early potatoes the juice may require to be much diluted. With certain potatoes I obtained the best results by adding 1 part of juice to 9 parts of water. This, however, will be discussed in a future paper upon the nutrition of the bacteria.

Accordingly, tubes of molten glucose-gelatine were infected with fragments of the soft gum, and some of these were poured into Petri-dishes at once, while others were poured after various periods of incubation at 30°. The colonies that developed from the plates were chiefly those of *Bact. acaciæ*. A few other bacteria were obtained, but as these could not be induced to produce gum upon saccharose-potato-agar, or the same with tannin, they were probably adventitious.

Most of the races of *Bact. acaciæ* were similar to the type which I have previously described, but another kind occurred which differed from the type in growing as a brownish-yellow mass on saccharose-potato-agar instead of the buff-yellow of the type.

The natural gum, from which the bacteria had been isolated, when treated with water partly swelled and partly dissolved. The portion which swelled showed rounded faces and corners; most of it dissolved in the course of a month, and doubtless it would all have dissolved in time. Upon hydrolysis with 5 % sulphuric acid the gum acids yielded a solution of reducing sugars which consisted of arabinose and galactose. These were identified by means of the osazones which were prepared and purified in the manner already described in the first of this series of papers.

In view of the slow solubility of the portion of the gum it appeared probable that *Bact. metarabinum* would occur among the bacteria, but although various methods were tried, and various media were employed, this organism could not be isolated. This failure to obtain the organism, however, does not necessarily imply that it had no part in the production of the natural gum. The separation is attended with difficulty on account of the insoluble nature of the gum which it produces. The slime masses of *Bact. metarabinum*, instead of dissolving and liberating the bacteria like *Bact. acaciæ*, remain intact, and thus a clump of bacteria grows as a single organism. Thus in plate culture *Bact. acaciæ* might so outnumber *Bact. metarabinum* as to prevent the isolation of the latter. Again, the age of the specimens from which the bacteria were obtained might have much to do in bringing about the practical suppression of *Bact. metarabinum.*

One of the races of *Bact. acaciæ* had, however, differed from the normal type, and there was the possibility that this race might produce an insoluble gum, so in order to test this point a quantity of the slime was prepared. It was noted that the race was very vigorous, and produced a good quantity of slime. The pure gum acids, when taken from the alcoholic solution in which they had been precipitated, dissolved readily in water. Drying for several hours at 100° in the steam bath did not affect the ready solubility, from which it is evident that the bacterium was really a race of *Bact. acaciæ.*

The investigation showed that the gum-flux of the plum was due in part at least to the action of *Bact. acaciæ.*

VI.—THE GUM-FLUX OF THE CEDAR.

The gum-flux of the cedar has been already noted by Maiden,* who thus describes the gum—"It is a very pale yellow gum . . . swells largely in cold water, and in the course of 24 hours it nearly wholly dissolves . . . leaving a small percentage of metarabin."

A few twigs of the red cedar, *Cedrela australis,* F.v.M., bearing small amber-coloured tears of gum were forwarded to me by Mr. H. W. Potts, Principal of the Hawkesbury Agricultural College, and in the letter which accompanied the samples he said, "They were found on trees growing in Richmond. The gum appears to exude in all cases at points attacked by some grub, possibly that of the Red Cedar Moth, *Epicrosis.*"

Portions of the twigs were passed rapidly through the bunsen-flame to sterilise the outer surfaces, and were afterwards cut up with a sterile knife and introduced into tubes of molten glucose gelatine. Some of these tubes were poured into plates at once, others were incubated at 30° for 1, 2, 3, 4 and 5 hours before being poured into Petri-dishes. From all the plates colonies of bacteria were readily obtained, and most of these were *Bact. acaciæ.* The slime bacillus, *Bact. persicæ*, n.sp., first isolated from the peach, was also found, together with a few inert bacteria. The latter could not be induced to produce gum, and must therefore be considered as being adventitious saprophytes.

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* Maiden, These Proceedings (2), iv. 1047.

The gum-flux of the cedar is thus shown to be caused by *Bact. acaciæ*, the metarabin portion probably being contributed by the slime bacillus of the peach, *Bact. persicæ*, n.sp.

VII.—THE GUM-FLUX OF THE PEACH.

When the fruit of the peach-tree is affected with gum-flux, drops of an almost transparent, colourless and gelatinous gum exude from insect punctures or wounds upon the surface. Specimens of peaches diseased in this manner were received from Mr. H. W. Potts, Principal of the Hawkesbury Agricultural College. Some of the peaches contained the gum under considerable pressure, for upon cutting across the lower ends of the chambers containing the stones, large globules of gelatinous gum immediately protruded.

The microscopical examination of stained films of the gum showed the presence of immense numbers of small badly staining (and therefore probably dead) bacteria. In this respect, as well as in the microscopical appearance, the gum from the peach fruit was identical with gum from similarly affected almonds. In confirmation of the deduction drawn from the microscopical observations it was found that, although many portions of gum and gum-saturated tissue were infected into gelatine and other media, only a few colonies of bacteria were obtained. The few colonies that developed from about a dozen plates were those of *Bac. levaniformans* and another sporulating bacillus, *Bact. persicæ*, n.sp., which will be described in a future paper. A few yeasts were also obtained, but in view of the undoubted bacterial origin of the gum, as shown at any rate by the microscopical appearance of stained gum films, they were considered as having nothing to do with the production of the gum.

The presence of dead bacteria in the gum found inside the fruit points to the gum being formed in the stem, and being forced into the rapidly growing fruit, where the bacteria are killed by the greater acidity of the fruit juices as compared with the stem fluids. If this be the case the bacteria which produce the gum should be found in the vessels of the twigs attached to the fruit. To test the matter fresh specimens of gummed peaches were obtained from Mr. Potts, and from these new cultures were made. The colonies that grew upon plates which had been infected with the twigs to which the fruits were attached consisted chiefly of *Bact. acaciæ*. The others consisted of the slime bacillus (*Bact. persicæ*, n.sp.), *Bac. levaniformans*, and a dematium-yeast which appeared capable of producing slime. From eight portions of gum and fruit pulp of the new specimens of fruit there were obtained an inert bacillus, an inert coccus, an inert sarcina, and many colonies of a small yeast and the dematium-yeast. In the twigs the yeasts were in the small minority, while in the fruit they predominated.

From this investigation it appears that the gum which exudes from punctures and wounds upon peaches, and is found saturating the soft tissues, has been formed in the stem and branches. The bacteria which produce the gum are chiefly *Bact. acaciæ*, but other bacteria also contribute, and the chief of these is the slime bacillus, *Bact. persicæ*, n.sp. *Bacillus levaniformans* is practically inert, for the gum levan that it produces would be immediately hydrolysed. This organism may, by virtue of its inverting action, play a part in assisting the other bacteria to produce gum, but this is doubtful.

The dematium-yeast grows as a tough skin upon saccharose-potato-agar, and possibly consists of cells cemented together or embedded in a slime matrix. It will form the subject of a future investigation. But even should it be proved to be capable of producing slime, its practical absence in film preparations of the fruit gum, and the overwhelming majority of bacterial remains, is sufficient to show that the gum is a bacterial and not a yeast product. This is important because the gummosis (? gum-flux) of the plum has been ascribed to a similar dematium-yeast by Massee.*

The investigation showed that (1) the gum that exudes from peaches is formed in the stem and branches; (2) it has a bacterial origin, and (3) it is produced chiefly by *Bact. acaciæ*.

VIII.—THE GUM-FLUX OF THE ALMOND.

The gum-flux of the almond showed† many points in common with the gum-flux of the peach. The fresh gum that exuded from punctures and cracks in the fruit was of the same colourless, almost transparent appearance and gelatinous consistency, and when examined microscopically the same badly staining short bacterial forms were observed. Moreover, when glucose-gelatine plates were prepared with media infected with portions of fresh gum and gum-saturated fruit-tissue, bacterial colonies were conspicuous by their absence; colonies of yeast-like organisms were obtained.

As in the case of the peach, many bacterial colonies and but few yeast colonies developed upon plates which were prepared with media infected with portions of twigs, the exterior of which had been sterilised by passage through a flame. The bacteria consisted chiefly of *Bact. acaciæ*. The other colonies, which were few in number, included *Bac. levaniformans*, the gum-levan organism, and the slime-forming bacillus which had been first isolated from the peach and which has been named *Bact. persicæ*, n.sp. The dematium-yeast also obtained from the peach was isolated, but as it constituted about 1 % of the colonies, it probably had little effect in determining the composition or nature of the gum.

The investigation showed that (1) the gum-flux of the almond is identical with the gum-flux of the peach; (2) the gum is a bacterial product; and (3) the chief active organism is *Bact. acaciæ.*

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* Massee, Kew Bulletin, 1899.

† The specimens of affected fruit were sent by Mr. Fred. Stoward, Adelaide.

IX.—THE GUM-FLUX OF AN UNKNOWN STOCK OF THE JAPANESE DATE-PLUM.

A twig* of a seedling tree used as a stock for the Japanese date-plum, and apparently a species of Diospyros, showed small tears of an amber-coloured gum exuding from wounds upon the surface.

Two gum-producing bacteria were isolated by means of plate culture from the woody tissue. One of these was *Bac. levaniformans*, the other was *Bact. acaciæ*, which was undoubtedly responsible for the production of the exudation.

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* The specimen was sent by Mr. H. W. Potts, Principal of the Hawkesbury Agricultural College.

NOTES ON AUSTRALIAN *RHOPALOCERA*:

LYCÆNIDÆ. PART III.—REVISIONAL.

BY G. A. WATERHOUSE, B.Sc., B.E., F.E.S.

(Plates ii.-iii.)

This Part contains the descriptive portion of the remainder of this family; it also deals fully with the nomenclature, which I found in a state of great confusion. In every case I have stated my reasons for a change in either the generic or specific name.

I must here tender my thanks to Messrs. R. E. Turner, G. Lyell, R. Illidge, and Dr. A. J. Turner, who have placed their collections at my disposal and have given me examples of many rare species. Without the advice and extensive collection recently made by Mr. R. E. Turner, who re-discovered several rare species, this paper would not have been nearly so complete. Messrs. O. Lower, J. F. Haase, W. W. Froggatt, F. Brown, H. Tryon, and J. A. Kershaw have also aided me with the loan or gift of specimens; and I have been given ample opportunity of examining the collections in the Macleay, Queensland, and Australian Museums, receiving many valuable notes from our veteran entomologist, Mr. G. Masters.

In dealing with measurements, I have given the lengths of the costa of forewing from base to apex, taken from my own cabinet collection of fifteen hundred specimens, and seven hundred specimens in the collection of Mr. G. Lyell, so that with few exceptions the figures may be regarded as exceptionally accurate. To each species is appended the number of specimens (not necessarily all in my own collection) upon which I have based my remarks. In future Parts I hope to present many unrecorded notes on life-histories, to deal with the question of geographical and bathymetrical distribution, and to give some notes on the localities visited by earlier collectors and the present location of their types.

I have availed myself very extensively of the writings of Messrs. L. de Nicéville and H. H. Druce; indeed, the bulk of the generic alterations I have made in this paper, are taken from letters received by Mr. R. E. Turner and myself from the former gentleman, who, had he lived, would have undertaken the revision of the Australian *Rhopalocera*, based on the extensive material sent him by Mr. Turner and myself.

With reference to the limits for which I propose to use the term Australian, I have adopted the present political boundaries of the Australian States. This presents no difficulty, except with regard to the islands in Torres Straits, where the political boundary of Queensland extends to within a few miles of the New Guinea coast. But though the northern islands possess a fauna allied to that of New Guinea rather than to that of Australia, it is impossible to draw any but the political line, unless we exclude Torres Straits entirely, which would be unwise, as the group around Thursday Island belongs exclusively to Australia. There is no deep sea strait between Australia and New Guinea, and Profs. Haddon, Sollas and Cole* have shown that geologically these islands belong to Australia. For my present purpose, however, this question does not apply to any great extent, for, exclusive of Thursday Island, the only collection from Torres Straits is that from Darnley Island in the Macleay Museum, and that is included in the present Part.

I have purposely refrained from describing any new genera, though I have indicated one or two cases in which such are probably necessary. This is a work that can better be undertaken by competent entomologists outside Australia, who have access to general collections, rather than by one working on a restricted area, for most of our genera are identical with Indian forms, and some with African. The question of the description and determination of Australian species can best be solved in the tralia, where the collections are better and larger than elsewhere. For the purposes of this paper I have examined ten large collections of Lycænidæ, aggregating about four thousand specimens, and in addition I have seen the rarer species from three other collections amounting to over another thousand.

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* Trans. Irish Acad. xxx. Pt. xi. 1894.

An undertaking that would be of great benefit to Australian entomologists would be the redescription and figuring of many of the older species, the types of which are in London, such as the Fabrician species from the Collection of Sir Joseph Banks; and Hewitson's species, many of which are imperfectly described and figured, and supplied with very vague localities.

Family LYCÆNIDÆ.

"*Forelegs* slender and evidently smaller than the rest, but nearly alike in the sexes, used for walking, scaly; tarsus of the male long, exarticulate; that of the female jointed like in the hindlegs. *Forewing* with the subcostal nervure emitting two, three, or rarely four branches; the discoidal cell generally narrow owing to the distance between the costal and subcostal nervures; upper discocellular nervule wanting. All but one or two of small size. *Hindwing* scarcely channelled to receive the abdomen, often with one or more slender tails; præcostal nervure apparently wanting. *Body* rather slender except in *Liphyra;* antennæ short, often ringed with white, with an elongate distinct club; palpi usually elongate, terminal joint slender, horizontal, and nearly naked" (de Nicéville).

In addition to the above-mentioned sexual differences, the males often have differently placed scales or long hairs, such as the large almost circular patch on the forewing of *H. phorbas*, and the long black hairs on inner margin of the underside of forewing in *R. simsoni*. Where any difference in the size of the palpi occurs, those of the female are the longer.

The larvæ are onisciform, mostly night feeders, and in a great histor cases are attended by ants. The pupa is attached by metricalh a girdle round the middle, and is found under pieces of bark, in cracks, under stones, or even just under the surface of the soil. I hope in a future Part to deal fully with the ova, larvæ and pupæ of this family, respecting which I have many notes.

The only previous attempt to deal with the Australian *Lycænidæ* is included in Mr. W. H. Miskin's "Synonymical Catalogue of the Rhopalocera of Australia."* This work supplied a longfelt want, and must be used as a starting point for any revision of the Australian butterflies; and I am much indebted for the valuable synonymy contained in it. As Mr. Miskin clearly foresaw, a great many of the names have to be sunk. This I am fortunately able to do, for with a far greater number of specimens representing a larger number of species available for study, and an acquaintance with literature that he had not seen, I am enabled to recognise 114 species of Australian *Lycænidæ*. Of these 94 are in my own collection, and with six others from the Macleay Museum are exhibited to-night; of eight additional species I have seen specimens, and five others are known to me from figures, leaving only one, *M. euclides*, unaccounted for. *Zerites thyra* and *Lycaena hypoleuca* I do not regard as Australian. Miskin gives a list of 117 different names, 23 of which are marked as representing species unknown to him, so that he was only able to recognise 94 species, two or three of which I believe to be doubtfully distinct. On a careful examination of his list, I find 97 distinct species included (excepting *Z. thyra* and *L. hypoleuca*) to which I have added 14 new species described since 1891, two new records, while one of his synonyms has been raised to specific rank. The genera he uses I do not at all agree with, as they are not in accord with those used for the Indo-Malayan Region, whence so many of our species have been derived; nor does he use them in the same sense as the authors he quotes for them. For example, Miskin quotes de Nicéville for *Lycaena*, Fabr., listing eighteen species, not a single one of which would be placed in that genus by de Nicéville. Again, Moore, Distant, and de

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* Annals of the Queensland Museum, No. i., 1891.

Nicéville are quoted as authorities for *Deudorix*, Hew., yet all these authors would place two of the four species mentioned under that genus by Miskin in *Rapala*. This will show that the genera as well as the species are sadly in need of revision. I do not think Miskin possessed a large extra-Australian collection, which will account for his want of appreciation of generic differences. His descriptions of species are invariably good, though he has neglected comparative work; for instance, he describes three species as allied to *Hypochrysops ignita*, but does not indicate what form of that very variable species he refers to. This, however, is a small matter compared with the bad descriptions and very misleading figures of certain other Australian authors; three writers in particular have described nineteen *Lycænidæ* as new, only one of which has claims to specific rank.

The system of classification I have used is based on the excellent table of the late Mr. de Nicéville, but any system can only be held to apply directly to the limited area under consideration, so that I have found it necessary to depart somewhat from his table. The first separation that occurs is the placing on one side of the genus *Liphyra*, which only just finds its true place among the *Lycænidæ*. I find that in Australian forms the presence or absence of an anal lobe is a good character.

KEY TO AUSTRALIAN GENERA OF LYCÆNIDÆ.

I. Forewing never with four subcostal nervules in ♀.
  A. Hindwing without anal lobe.
    A. Upperside in both sexes black, or black and white.
      a^1. Forewing with first subcostal anastomosed with costal for a very short distance and running free to costa.......... *Eupsychellus.*
      b^1. Forewing with first subcostal far from costal; costa arched.......... *Neopithecops.*
      c^1. Forewing with first subcostal free from costal; costa straight.......... *Megisba.*
    B. Upperside of ♂ blue and white, of ♀ black and white.
      a^1. Forewing with first subcostal free from costa...... *Cyaniris.*

b^1. Forewing with first subcostal anastomosed with costal and then running free to costa..... ...... *Danis.*

c^1. Forewing with first subcostal connected with costal by a short spur.. *Lampides.*

c. Upperside of ♂ blue, purple, or brown; of ♀ usually blue, sometimes a white patch on forewing.

a^1. Forewing with first subcostal entirely free from costal.

a^2. Underside with brilliant markings, usually scarlet, sometimes greenish..................... *Miletus.*

b^2. Hindwing tailless, underside white or brown, with dark markings.............................. *Candalides.*

c^2. Underside white with few markings............. *Philiris.*

d^2. Hindwing with three blunt tails.............. ... *Pseudodipsas.*

e^2. Hindwing with three highly ciliated tails....... *Lycaenesthes.*

f^2. Hindwing with one filamentous tail............. *Polyommatus.*

g^2. Upperside in both sexes coppery............... .. *Lucia.*

b^1. Forewing with first subcostal very near to or touching costal, but not anastomosed with it.

a^2. Hindwing with one filamentous tail.

a^3. Underside with few markings................ *Catochrysops.*

b^3. Underside with a complicated system of brown and white splashes.............. ..... *Tarucus.*

b^2. Hindwing tailless.

a^3. Hindwing with four black spots on outer margin below.................................. *Chilades.*

b^3. Underside with catenulated markings, never more than two black spots at anal angle below.................................... ...... *Zizera.*

c^1. Forewing with first subcostal connected with costal by a very short spur................................ *Jamides.*

d^1. Forewing with first subcostal anastomosed with costal for a variable distance and running free to costa; usually a single tail.

a^2. Hindwing below base with black spots.......... *Everes.*

b^2. Hindwing below base without black spots, both wings with catenulated bands, tailed and tailless.... .... *Nacaduba.*

e^1. Forewing with first subcostal completely anastomosed with costal, except short free basal portion.

a^2. Hindwing somewhat dentate; of small size... *Una.*

b^2. Hindwing with a single tail....................... *Utica.*

B. Hindwing with a rudimentary anal lobe.
  A. Sexes very dissimilar, ♂ purple or silvery-blue, ♀ usually with pale patch on forewing.................. *Ogyris.*
  B. Sexes very similar, purple or blue, hindwing with a stout tail....................... .... *Arhopala.*
C. Hindwing with anal lobe.
  A. Hindwing usually with a long tail to first median.
    a^1. ♂ with three or four subcostals, ♀ with three; spots in cells on underside.......... .... *Ialmenus.*
    b^1. Both sexes with three subcostals, no spots in cells on underside................................. .... *Pseudalmenus.*
  B. Hindwing with two equal filamentous tails, forewing with two subcostals.
    a^1. Both sexes black and white... .... *Pseudonotis.*
    b^1. ♂ with circular black patch on forewing............ *Hypolycaena.*
  C. Hindwing with one tail and well developed anal lobe, three subcostals in both sexes.
    a^1. ♂ with no secondary sexual characters......... ... *Deudorix.*
    b^1. ♂ with secondary sexual characters on both wings..... .... *Rapala.*
    c^1. ♂ with secondary sexual characters, tail nearly 1 inch in length .. .. *Bindahara.*
II. Forewing with four subcostals in both sexes .... *Liphyra.*

But for the presence of two tailless species of *Nacaduba*, the classification might be much simplified by adopting a tailed and tailless section among the group having no anal lobe.

EUPSYCHELLUS, Röber.

Tijdschr. v. Ent. xxxiv. p. 316; Exot. Schmett. Theil ii. p. 273, 1892.

This genus stands midway between *Pithecops* (first subcostal and costal completely anastomosed) and *Neopithecops* (these nervules quite separate) in that the first subcostal only touches the costal for a very short distance and then runs free to the costa.

Type, *E. dionsius*, Boisd.

EUPSYCHELLUS DIONISIUS, Boisduval (Plate ii., fig. 1).

Voy. Astr., Lep. p. 82, 1832: *Pithecops dionisius*, Druce, P.Z.S. 1891, p. 358, pl. xxxi. fig. 1.

16 mm. Upperside.—*Forewing* with costal margin brown, apex broadly brown, outer margin brown decreasing in width to angle, basal fourth brown, rest of wing pure white; this white area almost circular, occupying ½ cell, extending above it and also reaching inner margin *Hindwing* brown, with a white almost circular apical area, which beginning at about the middle of costa extends downwards just into the end of cell and then round towards apex.

Underside.—*Forewing* white, with much more restricted brown margins. Costa only narrowly brown, apex and outer margin less broad than on upperside; brown outer margin marked with a faint series of dots between the nervules, inside of which is another series of larger white dots. A black spot in middle of cell towards costa, a second above the cell and below subcostal nervule, and three irregularly between nervules at about ⅔ length of costa; these three extend at intervals along inner edge of outer marginal band. *Hindwing* white, with a brown narrow outer margin extending from near middle of inner margin nearly to apex; a fine marginal white line interrupted by the nervules, above which is another series of white dashes on the brown outer margin as on outer margin of forewing; towards anal area and above brown outer marginal band, three brown dashes running parallel to outer margin. The most striking feature of the underside is a very large *black* spot situated between costal and subcostal nervures, just above the end of cell. (In the allied smaller species *N. zalmora*, Butl., this black spot is situated *at the apex*).

The specimen (♂?) from which this description is taken is in the Macleay Museum from Darnley Island and is the only Australian specimen I know of. Having been caught many years ago, the colour has probably faded, and freshly caught specimens would in all likelihood be black and white.

This species is allied to the smaller form *N. zalmora*, also recorded from Darnley Island, but differs from that species in neuration and in the position of the large black spot on underside of hindwing.

This constitutes a new record for both genus and species for Australia.

NEOPITHECOPS, Distant.

Rhop. Malay. p. 209, 1884; de Nicéville, Butt. Ind. iii. p. 51, 1890: *Parapithecops*, Moore, Journ. Asiat. Soc. Bengal, liii. pt. 2, p. 20, 1884.

"*Forewing* small, very broad, elliptical; [costa] much arched from the base, exterior margin convex, posterior margin of equal length with the anterior; costal nervure extending to less than half length of margin; subcostal nervules very short, first subcostal emitted at one-half before end of discoidal cell, second at one-third before its end, third at one-sixth before its end, discoidal cell long, broad. *Hindwing* small, very broad, oval; exterior margin very convex. *Body* slender; *palpi* porrect, slender, clothed with short lax scales; *legs* slender; *antennæ* with a well-formed lengthened spatular club."

"This is a very remarkable little genus, which has a strong superficial likeness to *Pithecops*, Horsf., and moreover similar habits and flight in the perfect state. It has the costa of the forewing more strongly arched than in any other genus of this group, thus permitting of the wide separation of the costal nervure and the first and second subcostal nervules. The males have no secondary sexual characters" (de Nicéville, *loc. cit.*).

The type is *N. zalmora*, Butl., and the genus probably contains a single very variable species.

NEOPITHECOPS ZALMORA, Butler (Plate ii., fig. 2).

Pithecops zalmora, Butl., Cat. Fabr. Lep. B.M. p. 161, 1869: *N. zalmora*, de Nicév., Butt. Ind. iii. p. 53, 1890: *Pith. dharma*, Moore, Lep. Cey. i. p. 72, 1881: *Parapithecops gaura*, Moore, Journ. Asiat. Soc. Bengal, liii. pt. 2, p. 20, 1884: *N. horsfieldi*, Dist., Rhop. Malay. p. 210, 1884.

♂. 11 mm. Upperside.—*Forewing* brown, with a white central elliptical area occupying a portion of cell, but not extending to base or inner margin. *Hindwing* wholly brown. Cilia white.

Underside.—*Forewing* white, with a brown apical area, and a decreasing brown outer margin marked by two parallel series of white lines (one marginal) interrupted by the nervules. Cilia brown. *Hindwing* white with a marginal series of brown spots encircled with white; a large, black oval spot present between costal nervure and subcostal nervule at apex.

♀. 13 mm. Upperside.—*Forewing* with central white area smaller than in ♂. *Hindwing* with indications of a white marginal line.

Underside.—*Forewing* with brown outer margin broader, and the two white series of lines dividing up the brown margin into a series of spots; a further series of brown spots some little distance from the brown outer margin. *Hindwing* as in ♂, but with the addition of another series of submarginal brown lines.

The above descriptions are taken from what I believe to be the only two known Australian specimens, in the Macleay Museum, from Darnley Island; and these were caught a number of years ago. The colour of the upperside in freshly caught specimens will probably be black.

De Nicéville considers that the four described forms belong to one species. They vary from the wet-season form (*N. horsfieldi*, Dist.), which has no white on the upperside, to the dry-season form (*N. gaura*, Moore), which has large white areas on upperside in both wings. Intermediate between these two forms come typical *N. zalmora*, Butl., and *N. dharma*, Moore.

Almost the same variation as this is shown in the somewhat allied species *Megisba malaya*, Horsf.; but in Australia it is the whitest form of that species that is present, while in *N. zalmora* it is one of the darkest forms that we have, though it is quite possible that, when more specimens of these two species are obtained and at different times of the year, it will be found that they exhibit as much variation as they do in India and the Malay

Peninsula; and a further search will no doubt bring to light some form of *P. hylax* on Darnley Island.

MEGISBA, Moore (Plate iii., fig. 28).

Lep. Cey. i. p. 71, 1881; de Nicéville, Butt. Ind. iii. p. 60, 1890: *Pathalia*, Moore, Journ. Asiat. Soc. Bengal, liii. pt. 2, p. 21, 1884.

"In *Megisba* the costal nervure terminates about opposite to apex of cell; first subcostal nervure is bent upwards not far from its base towards costal nervure, the costal nervure having the appearance of being bent down to meet it, but the two veins are free, though they approach towards each other very closely in the male, not quite so closely in the female" (de Nicéville, *l.c.*).

This genus, the type of which is *M. malaya*, Horsf., is distributed through India, Ceylon, Burma, Sumatra, Java, Borneo and N. Queensland; and probably contains a single very variable species of which both tailed and tailless forms occur. In India five forms have been described, all of which have been placed by de Nicéville under the type species.

MEGISBA NIGRA, Miskin (Plate ii., figs. 3-4).

Lycaena nigra, (♀) Misk., Proc. Linn. Soc. N.S. Wales, 1890, 36: *M. nigra*, (♂) Waterh., Proc. Linn. Soc. N.S. Wales, 1902, p. 331.

♂. 9-10 mm. (average 10). Upperside.—*Forewing* black, with a white central area extending from median nervure to inner margin. Cilia brownish-black. *Hindwing* black, with a larger white-centred area extending often from just below cell to costa, leaving base and apical area black. Cilia brownish-black. In no Australian specimen that I have seen, has a tail been present.

Underside.—*Forewing* silvery-white, a pale brownish costal margin with four (sometimes five) almost black equidistant spots very close to costa about middle; apex pale brown, outer margin marked by a faint white line external to which are greyish cilia and internal to which is a pale brownish-grey margin, through which runs a white lunular band; somewhat internal to this is an irregular band of elongated brownish spots; end of cell faintly marked with pale brown. *Hindwing* silvery-white, three black subbasal spots, the middle one of them in cell; a round larger apical spot, a small one on inner margin about middle; outer margin as in forewing but a little wider; white lunules and marginal line almost breaking up the brownish-grey margin into a series of spots, that just at anal angle being darker and more conspicuous, spot between 1st and 2nd median nervules better defined than others. Cilia greyish.

♀. 10-12 mm. (11). Upperside differs from ♂ in the more convex costa and outer margins, rounded apex to forewing, and the very circular outer margin of hindwing. In some specimens the white areas are somewhat larger than those of ♂, and in very fresh specimens the cilia of hindwing are seen to be slightly spotted.

Underside as in ♂, but markings better defined and cilia decidedly spotted and lighter.

Loc.—Cardwell, Cairns, Q. (♂ 3, ♀ 2).

I am still inclined to regard this as only the Australian form of *M. malaya*, from which it differs only in the relative proportions of black and white on the upperside, and in the intensity of the markings below.

CYANIRIS, Dalman (Plate iii., fig. 1).

Kongl. Vetensk. Acad. Handl. xxxvii. pp. 63, 94, 1816; Moore, Lep. Cey. i. p. 74, 1881; de Nicéville, Butt. Ind. iii. p. 92, 1890: *Lycænopsis*, Feld., Reise Nov. Lep. ii. p. 257, 1865.

"*Forewing* elongated, triangular; costa very nearly straight; outer margin oblique and convex; costal nervure extending to half length of costa; first subcostal nervule free from costal nervure; third subcostal nervule emitted at about half way between apex and end of cell; subcostal nervure ending at apex. *Hindwing* oval, without a tail, anal lobe or any anal prolongation. . . . Type, *C. argiolus*, Linn., the 'Holly-blue of England.'"

This genus, as regards neuration, is very nearly allied to *Lycæna*, Fabr., a genus that is not at present represented in Australia, though many writers have used that name when describing Australian species of *Lycænidæ*.

The genus *Cyaniris* has a facies that distinguishes it immediately from any allied genus, the type of the genus well illustrating this facies, which is most marked on the underside, the spots hardly ever becoming ocellular; while in *Lycæna* they are composed of a dark centre and an outer pale portion. The genus occurs chiefly in the Neartic, Palæartic and Oriental regions, and in Australia so far contains the solitary species described below.

CYANIRIS TENELLA, Miskin (Plate ii., fig. 11).

Lycæna tenella (♀), Misk., Syn. Cat. Rhop. Aust. p. 63, 1891.

♂. 12-14 mm. (14). Upperside.—*Forewing* silvery-blue with a black outer margin and an almost central suboval white spot; costal margin broadly black at base, then a black linear margin to apex, where the broad black outer margin begins and extends to angle; a suboval white spot principally below cell (only a small lower portion of cell being white) and just reaching inner margin; rest of wing, surrounding the white spot except on its lower margin, pale silvery-blue. Cilia white. *Hindwing* white, with a black marginal line internal to which is a submarginal series of black spots surrounded with white between the nervules; internal to these spots is a continuous blackish suffusion from near apex to angle; abdominal fold white, internal to which is a suffusion of pale silvery-blue scales; base of wing brown suffused with blue scales, which are sparsely scattered over the submarginal black suffusion. Cilia white, terminations of nervules black.

Underside.—*Forewing* silky-white, with brown spots as follows, one faint in upper angle at end of cell, another larger between subcostal nervure and upper discoidal nervule, beyond this a band of brown spots running from below upper discoidal nervule to near angle parallel to outer margin, which is marked with a faint brown line, internal to which is a series of brown dots. Cilia white. *Hindwing* silky-white, with brown spots; a subbasal series of four spots, first between subcostal and costal nervures, second in middle of cell, third just below cell and nearer base than others, fourth near abdominal margin, a very conspicuous darker brown spot near costa at about middle, below which *may* be another spot smaller and paler, end of cell marked with a very faint brown line; beyond cell a crooked row of five spots from subcostal to median nervure, the second of which is larger and has its longer axis placed at right angles to the direction of the row; outer margin marked with a brown line internal to which is a series of brown spots between the nervules, above which again is a series of faint arches. Cilia white.

♀. 13-14 mm. (14). Antennæ, thorax and abdomen as in ♂; palpi longer than in ♂; forewing with costa slightly more arched, apex blunter, outer margin more convex.

Upperside.—*Forewing* white, with black costal and outer margins; central white suboval area larger than in ♂, otherwise the silvery-blue area of ♂ is replaced by black in ♀; base black, internal to which is a bluish suffusion, which faintly extends over a portion of white area. Cilia black, towards angle white. *Hindwing* as in ♂, but with slightly less blue.

Underside exactly as in ♂ and showing the same variation.

Miskin described the female only, and from a not too fresh specimen. A female of this species was submitted to the late Mr. L. de Nicéville, who thought his *C. ceyx** from Java might be identical with it. I have examined both his descriptions and figures (I think he figures 2 ♂'s and not ♂♀), and am of opinion that though closely allied they are two distinct species. H. H. Druce has described a species, *C. dilectissima*,† from Kina Balu, Borneo, which is allied to, if not identical with, the species under consideration, but I have not seen a specimen.

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* Journ. Bombay Nat. Hist. Soc. vii. p. 328, pl. H, figs. 6 and 7, 1892.

† P.Z.S. 1892, p. 571.

This beautiful little, rare and somewhat variable species is only recorded from the Cairns District, but no doubt it will in time be found to have a much more extended range.

Type specimen (♀) in Queensland Museum (♂ 2, ♀ 3).

DANIS, Fabricius.

Ill. Mag. vi. p. 286, 1807; Westw., Gen. Diurn. Lep. p. 497, 1852: *Damis*, Boisd., Voy. Astr. Lep. p. 67, 1832: *Thysonotis*, Hübn., Verz. bek. Schmett. p. 20, 1816; Druce & Baker, P.Z.S. 1893, pp. 536-553; Druce, P.Z.S. 1895, p. 585 (note).

The insects that are placed in this genus have a distinct facies that separates them from their allies. The males are of some shade of blue on the upperside, very often with white central areas; the females are black, with white central areas. On the underside of both sexes the margins and bases are black, but marked with blue scales, while the central areas are white; the outer margin of hindwing has a series of black oval spots surrounded by shades of blue. The neuration may be described as follows—subcostal nervure with three branches; first anastomosing with costal nervure and then running free to costa; second given off at or some distance beyond the point of emission of the first; third given off rather nearer apex than end of cell, while the subcostal nervure ends at or above the apex. A tail is present in one group at the extremity of first median nervule.

In Druce and Baker's Monograph they discard the name *Danis*, as they say the use of that name would affect the name of the type of the genus (*Danis danis*, Cram.); but as that appears to be their only reason, it is certainly one that I cannot agree with. It should be noted (as pointed out by Mr. Druce in 1895) that the figure of the neuration in their Monograph is faulty, the first subcostal being omitted at its proximal end, and the costal nervure at its distal end.

Druce and Baker go very fully into the history of this genus in their Monograph.

The Australian species may be recognised by the following table :—

A. *Upperside* in both sexes with a white patch on both wings; cilia dark, spotted with white.
  a. White area on forewing in ♂ small; no metallic scales on upperside in ♀ .... *apollonius.*
  b. White area on forewing in ♂ large; metallic scales on both wings on upperside in ♀ .... *serapis.*
  c. Of large size; colour grey-blue and no metallic sheen on upperside .... *syrius.*
B. No white area on forewing in ♂; white areas on both wings in ♀; of small size.
  a. Cilia unspotted .... *taygetus.*
  b. Cilia spotted .... *macleayi.*
C. Very small (if any) white area on forewing in ♂; white areas on both wings in ♀; of moderate size; a single tail to the hindwing in both sexes .... *arinia.*

On the underside the separation into three sections may be made as follows :—

A. *danis section* with black costal and outer margins of forewing continuous, a subcostal metallic band.

B. *taygetus section* with black costal and outer margins nearly divided by white subapical projection, a subcostal metallic band.

C. *cyanea section* with black costal and outer margins continuous, no subcostal metallic band.

DANIS APOLLONIUS, Felder (Plate ii., fig. 8).

Reise Nov. Lep. ii. p. 265, t. 33, f. 3, 1865: *Thysonotis apollonius*, Druce, P.Z.S. 1893, pl. xlv. figs. 5, 6: *D. danis*, Semp., Mus. Godf. Lep. xiv. p. 154, 1878 (nec Cram.): *D. sebæ*, Misk., Syn. Cat. Rhop. Aust. p. 49, 1891 (nec Boisd.).

♂. 22 mm. *Forewing* with costa very uniformly arched, apex fairly acute, outer margin nearly straight, inner margin straight. *Hindwing* with costa arched, particularly at base, outer margin rounded, without a tail or any anal prolongation.

Upperside.—*Forewing* blue, with black costa and outer margin and a white disc, rest of wing pale blue. Black costal margin extending to costal nervure and along apex and then more broadly along outer margin to angle; the white area wholly external to and below cell, extending from third median nervule sometimes up to inner margin and situated centrally, in width about ⅓ width of wing, ovoid in shape, with ill-defined borders; rest of wing pale blue, dull when viewed directly, but when viewed obliquely has a metallic sheen; nervules marked with black, base of wing covered with metallic green scales. Cilia black with a faint edging of white. *Hindwing* with outer half black, covered with dull blue scales, more particularly towards apical area; apical and anal portions of this black band without blue scales, base of wing bluish covered with a few metallic scales, extending about ⅓ into cell; rest of wing a broad white very well defined band extending from inner to costal margin and not continuous with white of forewing. Cilia black, spotted with white. Area between first median nervule and submedian nervure covered with long white hairs.

Underside.—*Forewing* with broad black costal and outer margins, with a metallic band running through its middle, rest of wing white; the black margin begins from base, occupies the whole of cell, and on costal portion does not extend below lower discoidal nervule and then broadly along outer margin to angle; the metallic blue band runs along middle of this black band, beginning at base, occupying part of cell, bent round at apex where it is widest and extending sometimes as far as first median nervule, but may end before this; nervules where they cross metallic band black, anal portion of black band duller than remainder; white area occupying nearly ½ area of wing. Cilia black, faintly spotted with white. *Hindwing* with outer half black, of same width as on upperside, the major portion of which is occupied by a series of metallic blue blocks, leaving a black outer margin and a wider black inner edge; metallic blocks, each of which contains a large ovoid black spot, separated from one another by black nervules; white of same size as on upperside, base black, with a large costal splash of metallic blue. Cilia spotted with white.

♀. 20 mm. Upperside.—*Forewing* black inclining to brown, with white central area, occupying ⅓ width of wing, not reaching cell, but extending from slightly beyond lower discoidal nervule to inner margin, better defined and of larger extent than that of ♂, and in parts sometimes sprinkled with brown scales. Cilia spotted. I can find not the slightest trace of metallic scales. *Hindwing* black and white, base black, broad black outer margin extending up to about end of cell; rest of wing white. Cilia between terminations of nervules white.

Underside as in ♂ except that the white areas are slightly purer in colour and the outer margins rather broader. As in ♂, the metallic scales of underside of forewing vary somewhat in extent on outer margin; white of cilia more developed than in ♂.

Loc.—Cape York (Macleay Mus.; ♂ 2, ♀ 2).

This species is nearest to *D. danis*, Cram. (*D. sebæ*, Boisd., of many writers), but in that species the female has metallic scales on the upperside. Druce and Baker in their Monograph refer the Australian species to *D. danis*, but then they had only males for examination. They remark, however, that the females would probably be without metallic scales on the upper side (as is the case) and that then the Australian species would agree with the New Guinea form which is *D. apollonius*.

The nearest Australian ally of this species is the somewhat smaller *D. serapis;* on the upperside both sexes are sufficiently distinct; on the underside the metallic scales in *D. serapis* are green, and in *D. apollonius* greenish-blue.

DANIS SYRIUS, Miskin.

Proc. Linn. Soc. N. S. Wales, 1890, p. 34.

I have lately seen the types in the Queensland Museum, which are, I believe, the only two specimens known. They are very closely allied to *D. apollonius;* in fact they may only be a variety of that species. The specimens differ in that they are very much larger, and are of a more dingy colour, wanting the metallic sheen. The male is somewhat like a very old specimen of *D. apollonius* in my own collection.

Loc.—Cape York.

DANIS SERAPIS, Miskin (Plate iii., fig. 20).

Syn. Cat. Rhop. Aust. p. 49, 1891: *Thysonotis serapis*, Druce & Baker, P.Z.S. 1893, p. 539, pl. xlv. f. 1, 2.

♂. 13-23 mm. (21); ♀. 16-23 mm. (21).

Druce gives excellent figures of this species; and Miskin's description is full.

Loc.—Cairns, Cardwell (♂ 20, ♀ 20).

This species is easily recognised, the female having metallic scales on the upperside of both wings. It is allied to the preceding but is smaller.

DANIS TAYGETUS, Felder (Plate iii., fig. 25).

Lyc. taygetus, Feld., Reise Nov. Lep. ii. p. 266, t. 33, f. 19-21, 1865; *D. taygetus*, Semp., Mus. Godf. Lep. xiv. p. 155, 1878; *D. salamandri*, Macl., Proc. Ent. Soc. N.S. Wales, i. p. liv., 1866.

♂. 13-17 mm. (16). Upperside.—*Forewing* uniform shining purplish-blue, with a very narrow black costal margin and a much broader black outer margin, nervules just before entering black margin defined in black. Cilia black, often tipped with white towards apex. *Hindwing* with outer margin black, of same width as forewing, nervules entering it black. Abdominal fold white, base purplish-blue, a broad white band with irregular edges from costa, where it is widest, right across wing; remainder of wing uniform shining purplish-blue. Cilia black.

Underside.—*Forewing* with outer margin black, broad at apex, decreasing in size to second median nervule where it sometimes suddenly becomes wide, continuing so to angle; this band often contains a faint submarginal white line. Costal margin evenly black, just internal to which is a band of metallic green scales, beginning from base, occupying upper half of cell and extending a little more than ¾ along wing; below this a band of black, occupying remaining portion of base, then decreasing in width (not filling whole of remaining part of cell) as it runs along the metallic band and joining black outer margin only by the narrow black costal strip. Rest of wing white, widest at inner margin, entering into lower corner of cell and with a narrow subapical projection from lower discoidal nervule to subcostal nervure. Cilia black. *Hindwing* with a broad basal splash of metallic green, bordered with black, which forms a continuation of the lower black band of forewing; followed by a cream band, widest at costa and very narrow at inner margin, inner edge of marginal black beginning from apex and running nearly straight to middle of inner margin; in this black outer margin are a series of large subquadrate metallic green spots each with a large ovoid black spot; these are interneural, extending from angle to subcostal nervure, above which is often a patch of green scales; outer margin black, internal to which is a more or less distinct white line interrupted by black nervules. Cilia black.

Var.—The whole hindwing on upperside, except black outer margin and an elongated white streak above subcostal nervule from apex to just beyond middle of costa, uniform shining purplish-blue. The male is very variable; on forewing the white edging to cilia in apical region is sometimes very marked, and sometimes absent; in hindwing the black outer margin varies in width. The white of hindwing varies from that of the variety described to the typical form, every intermediate stage being observed. On the underside the white submarginal line and the inner edge of black margin of forewing vary; in the hindwing the shape of the green spots and the enclosed black spots is variable; also, in continuation of the metallic green series, green scales may or may not be present above the subcostal nervure.

♀. 14-17 mm. (16). Upperside.—*Forewing* black and white, with base covered with metallic green scales which occupy nearly ⅓ cell; costal margin basally green, then narrowly black, broadening out about middle of cell and extending half-way into cell and continuing of about uniform width to apex and to angle; rest of wing white. Cilia black. *Hindwing* white, with a very broad black outer margin, its inner edge running from apex irregularly to anal angle. On the inner anal area of this band is a large patch of metallic green scales, base also coloured with metallic green. Abdominal fold white. Cilia black.

Underside as in ♂ but the light area of hindwing cream rather than white. The ♀ is also variable; on the upperside the metallic scales are often blue rather than green, and often a sprinkling of these scales is present on the inner edge of the black outer margin of forewing. On the hindwing the metallic patch near the anal angle is often wanting, or it may be very large and completely joined to the basal patch by a metallic line running between the median and submedian nervures.

The first subcostal is only united with the costal nervure for a very short distance. The male is somewhat like that of *D. arinia*, but is smaller and lacks the tail of that species.

The type of *D. salamandri* is in the Macleay Museum, and is certainly identical with this species.

This species ranges from the Richmond River to Cape York; and is very plentiful in certain localities, as the Richmond River and in the Cairns District where Mr, R. E. Turner informs me the variety of the male with little white on the upperside of the hindwing is as common as the typical form. I am sure the locality of Sydney must be an error, as after collecting for over twelve years in the district I have never seen it. Semper is the authority for this locality. (♂ 30, ♀ 20).

DANIS MACLEAYI, Semper.

Mus. Godf. Lep. xiv. p. 155, 1878: *Thysonotis macleayi*, Druce & Baker, P.Z.S. 1893, pp. 546, 547; Druce, *op. cit.* 1902, ii. p. 119.

♂♀. Length of costa of forewing 14 mm. This species is very close to the preceding (*D. taygetus*), but differs very slightly in the spotted fringes, also in the female having a black tooth projecting from the black costal border into the central white area and very indistinct blue scales on the base of the wings. The male is of a much less intense blue than *D. taygetus*. Loc. Cape York. (Translated from Semper's description).

In 1893 Mr. Druce doubted if it was distinct from *D. taygetus*, and referred to a specimen in the Godman and Salvin collection. In 1902 he had the types in his own collection and writes "easily distinguished from *D. taygetus* by the paler blue in the male and by the chequered cilia in both sexes."

I have lately seen a specimen (♀) from Cooktown lent me by Mr. Lower; it certainly has white, slightly chequered cilia, and though not altogether agreeing with the above description, does so in some respects. It further causes me to doubt the specific distinctness of this species but, in deference to Mr. Druce's opinion, I keep them separate.

DANIS ARINIA, Oberthür.

Cupido arinia, Oberth., Ann. Mus. Civ. Genov. xii. p. 465, 1878: *l.c.* xv. p. 523, 1880: *Thysonotis arinia*, Druce & Baker, P.Z.S. 1893, p. 550, pl. xlvi., figs. 6, 7: *D. cyanea*, Semp. (nec Cram.), Mus. Godf. Lep. xiv. p. 155, 1878; Misk. (nec Cram.), Syn. Cat, Rhop. Aust. p. 50, 1891: *D. albastola*, Lucas, Proc. R. Soc. Qsld. vi. p. 156, figs. 3, 4, 1889.

♂. 16-19 mm. (18). Shape of wings as in *D. taygetus* ♂ rather than *D. serapis* ♂, with a long thin tail at the extremity of the first median nervule of the hindwing.

Upperside.—*Forewing* uniform shining purplish-blue (darker than in *D. taygetus*) with a very narrow black costal margin and a broader uniform black outer margin; end of cell marked by a whitish suffusion more or less developed. Cilia black, more or less edged with white. *Hindwing* uniform shining purplish-blue, with a fairly broad outer black margin, between costa and subcostal nervule white. Tail long, black, tipped with white. Cilia black edged with white.

Underside.—*Forewing* white, with black costal and outer margins, costa at base narrowly white, black costal margin beginning at base runs uniformly in width to apex and round to median nervure when it increases in size by three steps to inner margin; outer margin faintly marked with white, a submarginal white band beginning from below apex and increasing in size to inner margin. Cilia black. There are no metallic scales. *Hindwing with costa white, basally sprinkled with metallic scales; a* subbasal broad black bar; a broad white bar from costa to inner margin; rest of wing black, with a submarginal series of interneural metallic green subquadrate spots each containing a large ovoid black spot. Outer margin marked with a definite white line, interrupted by the black nervules. Tail black, tipped with white. Cilia black, tipped with white.

♀. 15-17 mm. (16). Shape of wings as in *D. taygetus* ♀. Hindwing tailed.

Upperside.—*Forewing* white, central area with broad costal and broader outer black margins; base covered with metallic green scales, costal margin extending half-way into cell and increasing in size to apex; thence continuing, still increasing, to inner margin, inner edge irregular, a faint trace of a submarginal metallic band most noticeable near angle. Only a little more than $\frac{1}{3}$ of wing white. Cilia black. *Hindwing* with base black, sprinkled with metallic scales; next a narrow white band, remainder of wing black; a faint white marginal line interrupted by black nervules, above which is an interneural series of very black ovoid spots each of which is crowned with a large patch of metallic scales. Tail long, black, tipped with white. Cilia black, edged with white.

Underside as in ♂.

I have unfortunately only half-a-dozen specimens of this species which are not in the best condition, especially in the case of the females. They show very little variation except in the size of the white patch at end of cell in ♂. The recognition marks are the tail and the absence of any metallic scales on the underside of the forewing.

The species is intermediate in size between *D. serapis* and *D. taygetus*.

Loc.—Mackay to Cape York (♂ 6, ♀ 2.)

LAMPIDES, Hübner.

Verz. bek. Schmett. p. 70, 1816; de Nicéville, Butt. Ind. iii. p. 159, 1890.

"In the forewing the costal nervure is very short, terminating on the margin before the apex of the discoidal cell; the short spur joining the first subcostal nervule to the costal nervure is a feature present in *Jamides*, Hübner. Structurally this genus hardly differs from *Jamides*, and what differences there are are so slight that they can hardly be expressed; but the style of colouration and markings will easily distinguish them. Type *L. œlianus*, Fabr." (de Nicéville).

It will be noticed that Miskin* gives a list of seventeen species referred to *Lampides*, Hübn., not one of which can correctly be placed in that genus, as defined by the authors he quotes; while the two species that can structurally be referred to that genus he has placed under *Danis*, Fabr. It appears from Miskin's 'Catalogue' that the main distinction he adopts between *Lycæna* and *Lampides* is the absence of a tail in the former case, and its presence in the latter; but it may here be remarked that the same species is often found tailed and tailless. The species given by Miskin under *Lampides* are referable to *Nacaduba*, *Tarucus*, *Jamides*, *Everes*, *Utica*, *Polyommatus* and *Catochrysops*.

The two Australian species which structurally belong to this genus are very different in pattern from the Indian forms, as typified by *L. œlianus*. In our species there are no strigæ on the underside, and they are much more allied to *Danis* (*Thysonotis*, Hübn.).

The two species may be distinguished as follows :—

A. Male above silvery-blue; beneath, in both sexes, with white spots on outer marginal borders of both wings; no bands.... *cœlestis*.
B. Male above pale blue; beneath, in both sexes, with hindwing showing a series of conical black spots; bands on forewing, and a costal white line.. *aleuas*.

A tail is present in both species.

LAMPIDES CŒLESTIS, Miskin.

Danis cœlestis, Misk., Syn. Cat. Rhop. Aust. p. 50, 1891.

♂. 15-17 mm. (16); ♀. 11-16 mm. (15).

This species is recognised by the light silvery-blue of the male, and the black of the female, in both sexes with white central areas. Miskin's description is full. It is probably the species determined by Semper as *D. aleuas* from Cooktown. The only locality for it known to me is Cairns (♂ 2, ♀ 2).

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* Syn. Cat. Rhop. Aust. pp. 51-58, 1891.

LAMPIDES ALEUAS, Felder.

Lyc. aleuas (♂), Feld., Reise Nov. Lep. ii. p. 268, t. 33, f. 15, 16, 1865: *Danis aleuas*, Semp., Mus. Godf. Lep. xiv. p. 155, 1878: *Lyc. alcas* (♀), Feld., Reise Nov. Lep. ii. p. 268, t. 33, f. 27, 28, 1865.

♂. 18 mm. *Forewing* with costa arched, apex very blunt, almost rounded; outer margin nearly straight, inner margin straight. *Hindwing* with outer margin semicircular; a tail is present at extremity of first median nervule.

Upperside.—*Forewing* pale blue, with white discal patch which is ⅓ of width of wing, wholly external to cell, and wholly below median nervure, occupying a central position; apex and outer margin bordered with brown, rest of wing pale metallic blue (not so shining or silvery as in *L. cœlestis*), with costa and costal area plentifully sprinkled with white scales. Cilia very short, brown. *Hindwing* with outer half pale blue; base of wing pale blue; rest of wing white; outer margin brown, internal to which is a white line interrupted by blue at nervules, a brown patch on the inner side of each of this series of white lines. Cilia brown. Tail brown, tipped with white.

Underside.—*Forewing* brown and white, the brown occupying the same position as does the blue on upperside, basal third of costa marked by a white line, outer margin also marked by a white line external to which are the brown cilia; end of cell marked by a darker brown bar bounded by a white line on both sides and below; a short band is present near apex consisting of three darker brown spots bordered on their sides with white, placed one over the other, these spots are situated between 3rd subcostal nervule and subcostal nervure, subcostal and upper discoidal, and upper and lower discoidal nervules; a submarginal wavy white line, which is closest to outer margin at the nervules, double near apex. *Hindwing* with brown areas in a corresponding position to blue on upperside, white corresponding to white on upperside; a white marginal line interrupted by the nervules, between the nervules large conical dark spots bounded internally with white and externally with white suffused with blue scales, excepting the spot between 1st and 2nd median nervules which extends to the white marginal line, and has blue splashes on either side; internal to this, but still on the brown area, an irregular band of darker brown spots bordered with white, these spots occurring between each pair of nervules except above subcostal nervule and between subcostal nervule and subcostal nervure, where it is only a half spot. Cilia brown.

♀. 19 mm. *Forewing* with costa more arched, apex more rounded and outer margin more convex than in ♂.

Upperside.—*Forewing* with costal area and all above median nervure excepting the cell black, outer margin black, in width about ⅓ of wing, cell and basal area suffused with blue scales, rest of wing white; black of ♀ corresponding to blue of ♂. *Hindwing* with outer half black (corresponding to blue of ♂), rest of wing white except basal portion, which is suffused with pale blue; on inner edge of black area a blue suffusion in the region of median nervules; a very faint white marginal line in region of tail, which is black, tipped with white.

Underside.—Exactly as in ♂ except that the blue metallic scales are more plentiful on the white borders to the black spots of hindwing.

The above description is taken from a pair in the Macleay Museum caught at Darnley Island several years ago. I am not quite sure that our form is typical *L. aleuas*; but it is certainly very closely related to it, and without seeing a specimen from the type locality, I do not feel justified in altering the above name. I have some doubts as to whether Semper's specimen from Cooktown is really this species, as I do not think it occurs on the mainland (♂ 3, ♀ 1).

MILETUS, Hübner.

(Part) Verz. bek. Schmett. p. 71, 1816; (part) Westw., Gen. Diurn. Lep. p. 502, 1852: *Thecla*, sect. *Hypochrysops*, Feld., Wien. Ent. Mon. iv. p. 243, 1860; *Hypochrysops*, Feld., Reise Nov. Lep. ii. p. 251, 1865; Druce, Trans. Ent. Soc. Lond. 1891, p. 179.

In this genus the subcostal nervule is three-branched, the first branch being quite free from the costal nervure as in *Lycœnesthes*, *Pseudodipsas*, *Philiris* and *Candalides*. In fact *Miletus* bears a close relationship to these genera structurally, but may be at once recognised by the brilliant colouring of the underside. In his excellent Monograph of the genus, Druce remarks as follows: "Although by following certain lepidopterists, Hübner's name *Miletus* should take priority, as the first species mentioned by him is the *P. polycletus*, Linn., yet I prefer, seeing that these insects have become so well known under Felder's name, to use his name *Hypochrysops*. Again, Felder has definitely characterised the genus, whereas Hübner placed together under his name forms that are abundantly distinct, without any remark as to which should be the type of his genus." Following this rule then we must discard many of Hübner's genera, which Druce has not done, for he accepts *Candalides*, taking as the type the first mentioned species, *C. xanthospilos*, which seems very reasonable. Adopting then *P. polycletus* as the type of Hübner's genus, *Hypochrysops* must sink. With certain specific modifications, the species have the following pattern of marking on the underside. *Forewing* with cell usually yellow, a metallic line from base along subcostal nervure to end of cell where it is often broken, thence bending and following the discocellular nervules; a similar line running along middle of cell to near its end, but stopped by the discocellular spot, a discal band of variable length, usually margined with metallic; a submarginal band often represented by black spots sprinkled with metallic. *Hindwing* crossed by seven bands often composed of spots; first a basal streak on costa; second subbasal from subcostal to abdominal margin; third usually consisting of a spot above, another in cell, often coalescing; fourth usually consisting of four spots, one above, two below, one in middle of cell, crossing cell, all more or less coalescent; fifth marking end of cell, often with a small spot below it; sixth discal, much curved from near costa to abdominal margin, sometimes appearing as if its beginning and end belonged to the fifth series; seventh marginal, often much reduced in size. These spots which are usually some shade of rich orange-red, more or less bordered with metallic blue or green, sometimes with black, reach their maximum development in *M. ignita* and its allies. The species may be thus discriminated :—

A. Hindwing produced into two blunt tails, ♂ above blue, ♀ with white patch on forewing.	
a. Of large size, ♀ green above	*rex*.
b. Of smaller size, ♀ blue above	*rovena*.
B. Hindwing more produced at anal angle than apex, without tail-like projections.	
a. Upperside copper-colour.	
a^1. Hindwing below with white apical patch	*apollo*.
b^1. Hindwing below without white apical patch	*apelles*.
b. Upperside, ♂ purple, ♀ coppery.	*hecalius*.
c. Upperside, ♂ purple, ♀ blue.	
a^1. Underside with broad orange-red bands	*ignita*.
b^1. Underside with reddish-orange bands	*euclides*.
c^1. Underside with narrow orange bands	*chrysonotus*.
d^1. Hindwing below with a very distinct discocellular spot	*miskini*.
d. Upperside shining brown	*epicurus*.
e. Upperside with centrobasal areas metallic	*delicia*.
f. Upperside in both sexes blue.	
a^1. Hindwing below very dark	*narcissus*.
b^1. Hindwing below yellowish	*eucletus*.
c^1. Underside with bands of golden green	*halyætus*.

I have found it a difficult matter to draw up a satisfactory table of these species, for several of them are very closely allied and others are known to me only by figures.

Miletus rex, Boisduval.

Simæthus rex, Boisd., Voy. Astr. Lep. p. 72, 1832: *Hypochrysops rex*, Druce, Trans. Ent. Soc. Lond. 1891, p. 183; P.Z.S. 1902, ii. p. 113: *T. epicletus*, Felder, Wien. Ent. Mon. iii. p. 324, t. 6, f. 3, 1859.

This species is very closely allied to *M. rovena*, which is much commoner in Australia, but is larger. In the male the dark margins are much narrower, and on the underside the ground-colour is darker, and the whitish patch below apex of hindwing is wanting. In the female the basal areas are suffused with green instead of blue.

My authority for including this species is a specimen (♀) in the Macleay Museum from Darnley Island. I think it may definitely be assumed that it does not occur on the Australian mainland, where its place is taken by the form *M. rovena.* Druce was not certain of the distinctness of *M. epicletus*, Feld., (not the insect recorded under that name by Miskin). It is a well known New Guinea form.

Loc.—Darnley Island.

MILETUS ROVENA, Druce (Plate ii., fig. 16).

Hypochrysops rovena, Druce, Trans. Ent. Soc. Lond. 1891, p. 184; P.Z.S. 1902, ii. p. 113: *H. epicletus*, Misk. (noc Feld.), Syn. Cat. Rhop. Aust. p. 66, 1891.

♂. 16-17 mm. (17). Costa of forewing gently arched, apex acute, outer margin straight. Hindwing with outer margin slightly concave in centre, and two blunt tail-like projections to 1st and 2nd medians.

Upperside rich blue, with narrow black costal and outer margins, that of costa of hindwing being widest, usually extending to subcostal nervure, anal angle also more broadly black. Cilia brownish.

Underside.—*Forewing* light brown, paler towards inner margin, spots distinct, reddish margined with metallic green; an additional red spot in centre of cell, which is of the same colour as rest of wing except the reddish upper portion; discal band irregular, not extending below first median, marginal band indistinct. Cilia brown. *Hindwing* light brown with a lighter suffusion on outer margin below apex; spots red, usually black-bordered, then with metallic green, situated as indicated in general description except the curved discal series, which just below the subis situated almost on the outer margin, and then increasing size, gradually leaves the margin towards anal angle; marginal band represented by a red line, which at anal angle is internally bordered with black and externally by metallic green, light brown and then black on margin. Cilia brown at tips of nervules, at anal angle black.

♀. 17-18 mm. (17). Shape much as in ♂, but apex less acute and projections of hindwing longer.

Upperside.—*Forewing* black, with costa at base dark grey, basal third of wing light blue, more extended along inner margin, outer half of cell white, which extends downwards and outwards, sometimes reaching below 1st median; end of cell usually marked with bright blue which sometimes extends quite round the white patch. Cilia brown. *Hindwing* greyish black, with a variable blue suffusion extending over cell, sometimes beyond. Cilia brown, lighter at anal angle.

Underside as in ♂, usually lighter, with white patch of forewing showing through.

This species has usually been known in Australia as *H epicletus*, but Druce considers it distinct. However, this and the preceding species, together with *M. hypocletus*, Oberth , are probably only geographical forms of *M. polycletus*, Linn.

Loc.—Rockhampton to Cooktown (♂ 4, ♀ 3).

Druce records this species from Port Macquarie and Richmond River, N.S.W., erroneously I think, since it appears to be essentially a tropical species; and my own collections from the Richmond River were made at all times of the year and do not include it.

MILETUS APOLLO, Miskin.

Hypochrysops apollo, Misk., Syn. Cat. Rhop. Aust. Suppt. 1891.

Miskin's description was made from a single specimen (♀) in very poor condition. The type is now in the Queensland Museum, but in much worse condition and is hardly recognisable. It is to be hoped, therefore, that some northern entomologist will succeed in rediscovering this beautiful species. Its nearest Aust ally is *M. apelles.*

Loc.—Herbert River, Q.

MILETUS APELLES, Fabricius.

Pap. apelles, Fabr., Syst. Ent. p. 524, 1775; Don., Ins. New Holl. t. 30, f. 2, 1805: *Hypochrysops apelles*, Mathew, Proc. Linn. Soc. N.S. Wales, p. 265, 1885; Staud., Exot. Schmett. t. 94, 1888; Druce, Trans. Ent. Soc. Lond. 1891, p. 186.

♂. 14-17 mm. (15). Upperside.—*Forewing* rich orange-red, apical half of costa, apex and outer margin black, much wider at apex. Cilia inconspicuous, brownish. *Hindwing* rich orange-red, with costa broadly black and outer margin narrowly black, nervules marked with black. Cilia brownish.

Underside.—*Forewing* with apical area, angle and base below median nervule slaty to reddish-brown, rest of wing yellow; discal band nearly obsolete, represented by a few subapical yellow spots which run into the marginal band about middle; outer margin yellow, with a series of black spots well marked with metallic green; cell yellow, with two metallic lines; several metallic spots between end of cell and apex. Cilia brown. *Hindwing* brown, with broad red bands as indicated in general description, bordered with metallic green; discal band irregular, nearer to outer margin below subcostal, and giving off a spur above anal angle; marginal band confined to anal angle, bordered inwardly with black and outwardly with metallic green, which extends along margin; a yellow marginal line, a black spot at termination of first median. Cilia brown.

♀. 13-15 mm. (14). Outer margins of both wings more rounded than in ♂.

Upperside much paler and more restricted orange than in ♂, not extending to inner margin of forewing, nervules of hindwing markedly defined with black.

Underside as in ♂, with marginal band of forewing better defined.

Besides the colour of the upperside, this species may be recognised by the absence of a definite discal band on the forewing below. The locality of "West Australia" given by Druce must no doubt refer to the most northern portion of that State.

Loc.—Rockhampton to Cape York (♂ 8, ♀ 6).

MILETUS HALYÆTUS, Hewitson.

Hypochrysops halyætus, Hew., Trans. Ent Soc. 1874, p. 350; Druce, Trans. Ent. Soc. 1891, p. 185, pl. x. figs. 4, 5 : *Poly. uranites*, Meyrick, Proc. Linn. Soc. N.S. Wales, 1887, p. 827.

"♂. Wings above cærulean blue, with apical thirds brownish-black; hindwing with a submarginal orange band. Underside orange-yellow, with large metallic green spots along costa and at apex of forewing. Hindwing with three distinct wide bands of *metallic green*, the outer being composed of large oblong spots. Female as in male, but lilac-blue, with a linear orange outer margin to both wings. Exp. 1$\frac{3}{10}$in." (Druce).

Hewitson gives the male as brilliant morpho-blue; and the female lilac-blue above, with four bands of *brilliant gold-green* on the underside of hindwing.

Meyrick gives the male as of a brilliant light brassy-blue and the female purple-blue, the hindwings beneath bright yellow-ochreous, with three strongly curved series of moderate irregular trapezoidal more or less confluent *bluish-golden* spots.

Mr. O. B. Lower, who has seen a specimen of Mr. Meyrick's species, writes to me that "it resembled *M. ignita*, but all the scarlet of the underside was wholly replaced by metallic *blue-green* scales."

A very careful consideration of the descriptions, together with Mr. Lower's note, convinces me that *M. halyætus* and *M. uranites* are identical. I have long suspected this, but could not reconcile the colour given to the bands on the underside by Hewitson and Meyrick; still both Druce and Lower differ slightly from the earlier descriptions.

Loc.—Swan River, W.A. (Hew.), Geraldton, W.A. (Meyr.).

MILETUS MISKINI, n.sp. (Plate iii., figs. 30-31).

♂. 15 mm. Upperside.—*Forewing* dull lustrous purple, with black outer margin, broadest at apex, decreasing to angle. Cilia short brown. *Hindwing* dull lustrous purple, with a very narrow black outer margin. Costal margin from base to apex broadly brown. Abdominal fold grey. Cilia brown.

Underside.—*Forewing* stone-grey. Cell yellow, with a central metallic green waved line; subcostal nervure to end of cell marked with green, a basal green costal line; end of cell marked with an orange bar bounded internally with metallic green and externally with black, then metallic green; below middle and end of cell faint yellow spots; disc marked by a yellow transverse bar more or less sprinkled internally with metallic green reaching to first median nervule; margin marked with a broad decreasing band of orange, within which are five interneural black spots more or less obliterated with metallic green scales; on costa between discal band and end of cell are placed a few small spots of metallic green. Cilia brown. *Hindwing* stone-grey, with six orange-red bands; first along costa at base, internally bordered with metallic green; second basal along the commencement of costal nervure and continued across base of cell, bordered externally with metallic green; third subbasal, consisting of two elongate spots bordered on both sides with green, one above and one in cell; fourth extending right across wing a little beyond middle of cell, bordered on both sides with metallic green except the large spot near costa; fifth short, consisting of a very large conspicuous spot marking end of cell, bordered on either side first with black then with green, also below this a small spot; sixth discal, curved, internally bordered with green except towards abdominal margin where the large spot is bordered on both sides first with black and then with green; outer margin broadly orange, along which runs a submarginal interneural band of green, in region of anal angle this orange margin internally bordered first with black, then with green. Cilia brown.

♀. 14-18 mm. (17). Upperside.—*Forewing* with central metallic blue area and black costal and outer margins, black costal band extending half way into cell, very broad at apex and angle but narrower at middle of outer margin. Cilia grey. *Hindwing* purple, more or less suffused with blue at base, costal margin broadly brown, outer margin brown. Cilia grey. The relative amounts of blue and purple present vary according to the position of the insect.

Underside.—*Forewing* creamy-white; cell and adjoining costal area yellow, traversed by three metallic green lines from base, first close to costa, second marking subcostal nervule, third through middle of cell; end of cell marked by a yellow spot, bordered on either side by metallic green, above this towards costa a suffusion of metallic green; disc marked by a straight band of pale yellow internally bordered with green, especially towards costa; outer margin markedly yellow except at angle, with an interneural series of five black spots almost obscured with metallic green scales. Cilia grey. *Hindwing* creamy-white, with bands as in ♂, but the basal ones are rich orange-red and the discal band and outer margin are yellow. The large spot marking end of cell is very conspicuous, more so than in ♂. Cilia grey.

This species is named from a male in collection of Mr. R. Illidge, Brisbane, who has kindly lent it to me, and from several females in my own collection, received from Messrs. R. E. Turner, Tryon and Lucas. It is curious that out of fifty specimens examined only three have been males, whereas in this genus the males usually predominate. There seems to be very little variation except that the colour of the bands of the underside undergoes some change and the metallic scales often appear blue. The difference in the groundcolour of the sexes is very evident, and an important mark is the large spot at end of cell on underside of hindwing.

I have named this species after Mr. W. H. Miskin, in whose collection, now in the Queensland Museum, it appears under the name of *H. narcissus*, Fabr. Dr. Lucas has sent it to me as *H.*

eucletus, Feld. These two species, however, are *blue* on the upperside in both sexes, and are of a very different shape. A specimen sent to the late Mr. L. de Nicéville was returned labelled *M. protogenes*, Feld. (?), to which this insect appears from Druce's figure* to be somewhat allied. I have very carefully compared my specimens with the figures of *H. thesaurus*;† this species is the nearest I have seen to the Australian form, but the male has *purple* forewings, and *blue* hindwings; on the underside the colour is different and the discocellular of hindwing, which is an important mark of my species, is not prominent. The figure of the female on upperside is very close to my species, but the description of the underside says it is like the male but paler; whereas in my specimens the females are conspicuously lighter. A note on *M. protogenes* confirms my opinion that my species is distinct from that.

Loc.—Brisbane to Cairns.

MILETUS DELICIA, Hewitson.

Hypochrysops delicia, Hew., Ent. Mo. Mag. xii. p. 38, 1875; Druce, Trans. Ent. Soc. Lond. 1891, p. 186, t. 10, figs. 6, 7; And. & Spry, Vict. Butt. ii. p. 94, 1894.

♂. 15-20 mm. (18). Shape as in *M. ignita* ♂.

Upperside.—*Forewing* velvety black, with costa grey at base, centrobasal area silvery metallic green, extending to inner margin and occupying ½ to whole of cell. Cilia greyish. *Hindwing* as in forewing, with nervules marked in black in metallic area and two orange-red spots near anal angle.

Underside light brown, cell yellowish, bands of red, bordered with metallic as in general description, submarginal band of red without black spots, three black spots in and below cell of forewing as in *M. ignita*. Cilia brownish.

♀. 16-21 mm. (18). Shape as in *M. ignita* ♀.

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* Druce, Trans. Ent. Soc. Lond. 1891, pt. ii. pl. x. figs. 14, 15.

† G. Smith & Kirby, Rhop. Exot. pt. 30, 1894.

Upperside velvety black with variable centrobasal area metallic blue or green, occupying sometimes basal ⅓, sometimes ½ area of wings; orange spots on hindwing, two to four, sometimes coalescing. Cilia brown.

Underside as in ♂, with the central area of forewing broadly suffused with yellow in which the three black spots are very conspicuous.

Var. *duaringæ*, var.nov. ♂. 14 mm.

This specimen is much smaller than average males of *M. delicia* from Victoria, and New South Wales, and differs in having the metallic areas *pale blue*, occupying ¾ of both wings, leaving only a grey costa at base, and a broad black outer margin to the forewing; and narrower black costal and outer margins and two orange anal spots to hindwing.

Underside with spots and bands orange-red rather than red, discal bands more prominent than in southern forms, metallic borders blue rather than green, only two black spots on forewing.

The type of this remarkable variety, from Duaringa, Q., is in the collection of Mr. G. Lyell.

This beautiful species is somewhat allied to *M. ignita*, but is much larger and is the only Australian species with metallic scales on the upperside. Northern specimens are usually much larger and finer than southern. The species shows a certain amount of variation, especially with regard to the metallic scales of the upperside. Grose Smith & Kirby describe a species, *H. regina*,* from the Moluccas allied to, if not identical with, this. They state their specimen to be a male, but from the shape of the figure I should certainly say it was a female; in fact I have an almost identical female of *M. delicia* from New South Wales.

Loc.—Victoria; New South Wales, Brisbane (♂ 25, ♀ 12).

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* Rhop. Exot. pt. 32, 1895.

Miletus ignita, Leach (Plate iii., figs. 13, 32, 33).

Lyc. ignita, Leach, Zool. Misc. i. p. 136, t. 60, figs. 1-3, 1814: *Hypochrysops ignita*, Druce, Trans. Ent. Soc. Lond. 1891, p. 185; And. & Spry, Vict. Butt. ii. p. 97, 1894; *H. olliffi*, Misk., Proc. Linn. Soc. N.S.W. 1888, p. 1518.

♂. 10-16 mm. (14). Upperside.—*Forewing* brown, with much darker costal and outer margins, and often a dark discocellular bar; wing usually suffused with purplish-brown often shining, sometimes with a very distinct bluish tint; costa often brilliant orange, sometimes black; often a subapical orange patch, in one extreme case the whole of disc extending into cell and nearly to inner margin suffused with orange, though this is more often only represented by orange nervules; other extreme represented by broader dark margins and a total absence of orange. Cilia greyish-white. *Hindwing* brown, with darker costal margin extending to subcostal nervure, usually a very narrow black outer margin; wing similarly suffused with purplish-brown to the forewing, lower nervules often well marked with orange; in one extreme instance outer margin orange, with a thin black marginal line; some specimens have an orange suffusion in centre of wing, usually a darker discocellular spot. Cilia greyish-white, darker at terminations of nervules.

Underside.—*Forewing* light brown, cell and costa yellow, outer margin orange-red, rarely extending below first median; submarginal black and metallic spots the length of outer marginal orange band; discal band scarlet, usually bordered with black, sometimes with metallic, sometimes ending at first median, sometimes at submedian; last spot often a dark blotch, discocellular spot darker than cell, sometimes distinctly bordered outwardly with black; below this usually a black round spot, another often below middle of cell, often with a third in cell just above it; one specimen shows a faint subbasal black spot in cell. Cilia light brown. *Hindwing* light brown, crossed by scarlet bands bordered with metallic green or blue as indicated in general description; outer margin scarlet, with a thin black line, discal band often inwardly bordered with black, often with a large black spot between first median and submedian. Cilia light brown, darker at terminations of nervules.

♀. 13-16 mm. (14). Upperside.—*Forewing* brownish-black, with a very variable centrobasal area of purplish-blue of varying shades, usually extending to inner margin, usually occupying only ½ cell; costa rarely bordered with orange. Cilia white. *Hindwing* brownish-black, with centrobasal area purplish-blue, sometimes having a broad black outer margin, sometimes a linear outer margin inwardly bordered by orange; nervules sometimes marked with orange, especially near outer margin. Cilia greyish-white, darker at terminations of nervules, thus giving a dentate appearance to wing.

Underside as in ♂.

This is perhaps the most variable Lycænid in Australia; and though it would be possible to pick out from my cabinet six specimens which some entomologists would consider distinct, yet all intermediate stages occur, showing their specific identity. My description shows a wonderful variation in the males, of which I have caught at least 150 specimens; and I have had the opportunity of examining many others from W. Australia and Brisbane. There is very little difference in shape, except in one specimen which is much drawn out towards the apex of forewing, and the hindwing is more lobate. With fewer specimens available, I have not been able to note so great a variation in the females. In the Macleay Museum there is a specimen which has the scarlet spots of underside very wide, and only faintly bordered with metallic.

M. olliffi, from an examination of the types, I should certainly say was only the variety with little or no orange on the upperside. *M. chrysonotus* appears to be only the northern form of this.

Loc.—S.W. Australia, Victoria, New South Wales, Brisbane (♂ 35, ♀ 15).

MILETUS EUCLIDES, Miskin.

Hypochrysops euclides, Misk., Proc. Linn. Soc. N.S.W. 1888, p. 1517.

♂. Upperside.—Both wings dense purple, outer margins narrowly bordered with black.

Underside.—Pale stone-colour, adorned with reddish-orange bands and spots, all surrounded with margin of light metallic green. From Mr. Miskin's description the spots appear to be arranged as in *M. ignita*.

♀. Upperside.—Shining blue with a violet hue; borders of dark brown. Cilia of forewing black, of hindwing white. Termination of first median nervule developed into a decided tail. Exp. ♂ $1\frac{4}{12}$; ♀ $1\frac{5}{12}$ in.

The above is taken from the original description of specimens from Gippsland, Vic., but though Miskin says it approaches nearest, in appearance of underside, to *M. ignita*, he does not point out how it differs; personally, I believe it to be the Victorian form of that very variable species, but I have not been able to procure a specimen thereof from Victoria. Dr. Lucas, in whose possession the types were, informed me some few years ago that they had been unfortunately destroyed.

MILETUS CHRYSONOTUS, G. Smith & Kirby.

Hypochrysops chrysonotus, G. Smith & Kirby, Rhop. Exot. pt. 48, 1899.

♀. 18 mm. Shape as in *H. ignita* ♀.

Upperside.—*Forewing* brown, with centrobasal area slightly metallic purplish-blue, darker towards base. Cilia white. *Hindwing* brown, with centrobasal area purplish-blue. Cilia white.

Underside.—*Forewing* light brown, with bands and spots as in *M. ignita*, but pale orange; submarginal band orange-red, bordered outwardly with metallic blue and inwardly with black, which is well defined towards angle. Cilia brown. *Hindwing* light brown, bands and spots as in *M. ignita*, but much narrower and duller; outer margin pale yellow, black spot near anal angle very distinct. Cilia light brown.

This species, of which I unfortunately possess only a single specimen agreeing very well with the figure, is much larger and has lighter margins than the corresponding sex of *M. ignita*; on the underside the bands are much smaller, and the submarginal band of forewing is orange bordered with metallic and black as in *M. epicurus*, and not composed of black spots with metallic as in *M. ignita*. The male of this species is unknown, though it is more than likely that it may be contained in collections under the name *M. ignita*.

Loc.—Rockhampton to Cooktown.

MILETUS EPICURUS, Miskin.

Hypochrysops epicurus, Misk., Trans. Ent. Soc. Lond. 1876, p. 455; G. Smith & Kirby, Rhop. Exot. pt. 32, 1895.

♂. 15 mm. Shape as in *M. ignita* ♂, with hindwing rather more produced.

Upperside uniform shining brown with violet reflections, not extending to costal and outer margins; base of costa of forewing orange, which also shows on nervules of hindwing; two very short projections to first median and submedian. Cilia white, at terminations of nervules of hindwing brown.

Underside pale yellowish-brown, cell yellow, marked as in *M. ignita*, with submarginal band of forewing as in *M. chrysonotus*; bands very narrow, yellowish in forewing, reddish in hindwing; metallic borders very distinct, black subanal spot very distinct. Cilia brown.

♀. 15 mm. Hindwing not produced as in ♂.

Upperside uniform shining brown, violet-blue at base; hindwings with lower nervules well marked with orange, particularly near outer margin. Cilia white.

Underside as in ♂.

Of all the direct allies of *M. ignita*, this species is furthest removed from it. Miskin considered the markings of the underside to be "green, generally double, filled in with rich orange"; but an examination of his specimens, one of which is before me, shows it best to consider the markings as similar to those of *M. ignita*, but reduced in size, with the metallic borders much increased. A specimen in excellent condition in the Macleay Museum, from Sydney, has the hindwing much produced.

Loc.—Sydney, Brisbane (♂ 4, ♀ 1).

MILETUS HECALIUS, Miskin (Plate iii., fig. 35).

Hypochrysops hecalius, Misk., Trans. Ent. Soc. Lond. 1884, p. 94, ♀; Proc. Linn. Soc. N.S.W. 1888, p. 1516, ♂; And. & Spry, Vict. Butt. ii. p. 96, 1894.

♂. 13-15 mm. (13). Shape as in *M. ignita* ♂.

Upperside lustrous purple margined with black except inner margin of forewing, black margin widest at apex; hindwing with terminations of nervules orange-red, especially marked at anal angle. Cilia whitish.

Underside yellow merging into brown on inner margin of forewing, hindwing brown, both wings crossed by scarlet bands as in *M. ignita*, but not so clearly defined nor metallic borders as prominent; an additional scarlet bar in cell of forewing; submarginal bands extending to margins, and without black spots as in *M. ignita*. Cilia brownish.

♀. 14-16 mm. (15). Shape much as in ♂ but broader.

Upperside dark brown, with a central orange ovoid patch in each wing principally external to cell, that of forewing extending along median nervure decreasingly to base; outer margin of hindwing orange-red, with nervules entering it orange. Cilia brownish.

Underside yellow excepting inner margin of forewing, which is slightly brownish; markings as in ♂, but sometimes larger, usually much paler in colour, being very little different from the ground colour; coalescent marginal and submarginal bands sometimes nearly obsolete. Cilia brownish.

This appears to be a rare species, and is to be found in few collections. The undersides are variable, especially in the female, of which I have seen a specimen most brilliantly marked on the hindwing, and another in which the markings are hardly discernible. The female is unlike that of any other Australian species, but may be said to bear a superficial resemblance to *C. xanthospilos* ♀. The male is somewhat akin to *M. ignita* ♂.

Loc.—Victoria, Illawarra, N.S.W.

MILETUS NAROISSUS, Fabricius (Plate iii., fig. 34).

Pap. narcissus, Fabr., Syst. Ent. p. 524, 1775; Don., Ins. New Holl. t. 30, f. 3, 1805: *Hypochrysops narcissus*, Druce, Trans. Ent. Soc. Lond. 1891, p. 189.

♂. 13-16 mm. (15). Apex of forewing acute, outer margin straight, slightly concave just below middle. Hindwing much drawn out towards anal angle, somewhat dentate.

Upperside rich velvety black with centrobasal areas brilliant blue, which in forewing never enters cell, nor extends much beyond it, usually reaching inner margin; in hindwing usually reaching subcostal and submedian, and extending very nearly to outer margins. Cilia white, marked with black at termination of nervules, especially near anal angle.

Underside.—*Forewing* with costa and upper half of cell yellow, with two longitudinal metallic streaks, subapical area whitish, rest of wing blackish, discocellular spot reddish; discal band broad, short, red, bordered with metallic, bent towards middle of outer margin, which is orange marked with a series of black spots with metallic. Cilia whitish. *Hindwing* with ground colour blackish except along costa and middle of abdominal margin which are cream; bands as indicated in general description, confluent and less extensive, dark red bordered with silvery blue; discocellular almost obsolete, blackish; submarginal red, separated from the lighter marginal band by a silvery blue line. Cilia as above.

♀. 13-16 mm. (15). Apex of forewing less acute than in ♂; hindwing less drawn out, more dentate.

Upperside brownish-black, with centrobasal areas pale blue, more extensive on forewing, entering cell; less extensive on hindwing than in ♂. Cilia white marked with black.

Underside as in ♂, but the blackish ground colour always much lighter, usually cream except lower basal half of forewing.

Outside Australia this species appears to be represented only by the type (♂) in the British Museum; this is unfortunate, as it was the first of the section described. The species referred to by Miskin, and appearing in his collection at Brisbane under this name, has a *purple* male, and is more nearly allied to *M. protogenes* than this species. Specimens of true *M. narcissus*, however, appear in Miskin's collection, and in many others, under the name of *M. eucletus*, which I doubt to be Australian. *M. plotinus* (1894) and *M. dryope* (1895) figured in the 'Rhopalocera Exotica' belong to the same section as this species, which is also very close to the next.

Loc.—Cooktown, Thursday Island.

Miletus eucletus, Felder.

Hypochrysops eucletus, Feld., Reise Nov. Lep. ii. p. 253, 1865 Druce, Trans. Ent. Soc. Lond. 1891, p. 188, pl. 10, figs. 12, 13.

I know this species only from descriptions and from Druce's figures, upon which my remarks are based.

♂. 17 mm. (*from fig.*). Upperside as in *M. narcissus*, but with the blue somewhat paler.

Underside as in *M. narcissus*, with the yellow of forewing much more extensive along costa, the lower portion of forewing being less suffused with blackish, which appears from the figure to be totally absent from the groundcolour of hindwing. The female is said to differ from ♂ in having the blue of upperside paler and more extensive than in ♂; and the yellow groundcolour of hindwing below, being more or less suffused with dark purplish brown.

The type (♀) is from Gilolo, and my only reason for includin it in the Australian fauna is Druce's reference to Thursday Islan (Mathew). I have specimens of *M. narcissus* (♂♀) from bot

Cooktown and Thursday Island which are identical; and I am of opinion that Mathew's Thursday Island specimens were that species; but as *M. eucletus* is recorded from Southern New Guinea it is just possible that both forms may occur on Thursday Island, though I should rather be inclined to doubt it.

CANDALIDES, Hübner.

Verz. bek. Schmett. n. 73, 1816: *Erina* (part), Swains., Zool. Ill. ii. t. 134, 1832: *Holochila* (nom. præocc.), Feld., Verh. Zool. Bot. Gesell. Wien, xii. 1862.

Forewing with costa nearly straight in ♂, somewhat arched in ♀, apex slightly acute, outer margin nearly straight in ♂, more convex in ♀, inner margin straight. Subcostal nervure with three branches, first quite free from costal nervure, upper discoidal and middle discocellular meeting on or very close to subcostal. *Hindwing* with costa nearly straight, apex round, outer margin rounded uniformly, without any trace of a tail and no anal lobe, inner margin straight. Antennæ about ½ length of costa. Type *C. xanthospilos*, Hübn.

Swainson places in his genus *Erina* three Australian species, *pulchella*, Swains., *erinus*, Fabr., and *ignita*, Leach. The first is without any doubt a synonym of the type of Hübner's genus; the second would also be included in that genus, as it has a similar neuration; while the last belongs to a totally different type of insects. *Holochila*, type *H. absimilis*, was already used two years previously, so it must give way.

There are several Australian genera that, as regards neuration, are very close to *Candalides*, viz., *Lycœnesthes* which may at once be distinguished by the three short highly ciliated tails; *Miletus* (*Hypochrysops*) by the brilliant markings on the underside; *Pseudodipsas*, which connects *Candalides* with *Lycœnesthes*, has three blunt tail-like projections: *Philiris* has a similar neuration to *Candalides*, and it is only the shape that separates it from that genus; it moreover appears very difficult to separate it from *Pseudodipsas*, a view de Nicéville took, though Druce* does not concur; personally I think there is very little to warrant generic distinction between *Candalides*, *Pseudodipsas* and *Philiris;* but as they have been characterised with definite types, I prefer to let them stand, though I think that three (at least) of the divisions of *Candalides* are as worthy of generic rank. *Lycœnesthes* and *Miletus* are of course abundantly distinct.

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* P.Z.S. 1902, ii. p. 115.

The Australian species may be recognised primarily by their underside, as follows:—

- **A.** Underside in both sexes silky white, more or less marked with dark spots and lines.
  - *a*. Upperside, forewing with a yellow patch; underside with marginal row of spots, three spots in centre of hindwing .... *xanthospilos.*
  - *b*. Upperside purplish-brown; underside with marginal row of spots only .... *heathi.*
  - *c*. Upperside of ♂ uniform blue or greenish-blue, with narrow linear margins; of ♀ black, with a central white area to each wing.
    - *a*¹. Upperside of ♂ blue, with no secondary sexual characters; of ♀ basal areas blue, white patch of hindwing not reaching costa, markings below plentiful. *absimilis.*
    - *b*¹. Upperside of ♂ blue, with secondary sexual characters; of ♀ basal areas blue, white patch of hindwing reaching costa, markings below less than in *absimilis* .... *margarita.*
    - *c*¹. Upperside of ♂ bluish-green, with secondary sexual characters; of ♀ without blue on basal areas, white patch of hindwing reaching costa, markings below very few .... *helenita.*
    - *d*¹. Upperside of ♂ pale bluish, with secondary sexual characters; of ♀ bluish, with white areas much reduced, markings below very distinct .... *gilberti.*
- **B.** Underside in both sexes greyish to dark brown.
  - *a*. Two spots near hinder angle of forewing on underside.
    - *a*¹. Underside greyish, fringes white .... *erinus.*
    - *b*¹. Underside very light brown, spots distinct; upperside purple .... *hyacinthina*
    - *c*¹. Underside darker brown, spots very indistinct; upperside purple .... *acasta.*
    - *d*¹. Underside yet darker brown; upperside blue .... *cyanites.*

b. Underside brown, with unconspicuous markings; upperside coppery .... *cyprotus.*

C. Underside uniform brown, without markings; upperside silvery white .... *alboserícea.*

These are at once marked off into the *absimilis* group, in which the palpi are only clothed with very short hairs, and the terminal joint is very long, especially so in ♀; this group is very close to *Pseudodipsas.* The *erinus* group has much shorter and much more hairy palpi, and is related to the *absimilis* group by the whitish underside of *C. erinus.* The typical *C. xanthospilos*, by reason of the orange patch of the forewing, stands alone in the genus, which by its white underside it connects with *Philiris. C. heathi* connects the *erinus* group with *C. xanthospilos* and the genus *Philiris. C. cyprotus* is nearest to the *erinus* group, while *C. alboserícea* stands alone in the genus and is very distinct from every other Australian Lycænid.

CANDALIDES XANTHOSPILOS, Hübner (Plate iii., fig. 5).

Rusticus adolescens xanthospilos, Hübn., Samml. Exot. Schmett. 1806-16: *Hol. xanthospilos*, Staud., Exot. Schmett. pl. xciv. 1888; And. & Spry, Vict. Butt. ii. p. 89, 1894: *Polyommatus hübneri*, Godt., Enc. Méth. ix. p. 677, 1819: *Erina pulchella*, Swains., Zool. Ill. ii. t. 134, 1832: *Lyc. byzos*, Boisd., Voy. Astr. Lep. p. 81, 1832.

♂. 12-15 mm. (14). Upperside.—*Forewing* black, with centrobasal area suffused with shining purple, a large ovoid yellow spot below lower end of cell. Cilia whitish. *Hindwing* black, with central area slightly suffused with purple. Cilia white.

Underside silky white, with outer marginal interneural series of black dots better defined on hindwing, two black dots just at end of cell and one below middle of cell of hindwing. Cilia white.

♀. 13-16 mm. (15). Upperside as in ♂, but wanting the purplish suffusions, orange spot larger. Cilia white.

Underside as in ♂.

Loc.—Victoria, New South Wales, Brisbane to Rockhampton (♂ 15, ♀ 14).

This species is at once recognised by the orange spot of fore wing; it is allied to the Australian species of *Philiris*, excepting in shape.

CANDALIDES HEATHI, Cox (Plate iii., fig. 6).

Lyc. heathi, Cox, Ent. iv. p. 402, 1873; *Hol. heathi*, And. & Spry, Vict. Butt. ii. p. 93, 1894; *Lyc. paradoxa*, Guest, Trans. Roy. Soc. S.A. 1882, p. 36.

♂. 12-16 mm. (14). Upperside uniform shining slightly purplish-brown, with nervules paler brown and outer marginal borders darker. Cilia pale brown.

Underside pale greyish-white, with interneural outer marginal black dots variable in size and number, very fresh specimens showing bluish bases. Cilia white.

♀. 13-18 mm. (15). Upperside light brown with centro-basal areas blue. Cilia white.

Underside as in ♂.

Loc.—South Australia, Victoria, New South Wales, Brisbane (♂ 15, ♀ 13).

CANDALIDES ABSIMILIS, Felder (Plate iii., figs. 8-9).

Hol. absimilis, Feld., Verh. Zool. Bot. Gesell. Wien, xii. p. 490, 1862; Reise, Nov. Lep. ii. p. 261, t. 32, fig. 14-16, 1865; Olliff. Aust. Butt. p. 23, 1889; And. & Spry, Vict Butt. ii. p. 90, 1894.

♂. 15-17 mm. (16). Upperside uniform violet-blue, with very faint black costal and outer margins. Cilia white.

Underside.—*Forewing* silky white, with dark brown spots one elongate, marking end of cell; two transverse interneura series, one submarginal faint, the other discal more conspicuous sometimes an obscure series of brownish marginal blotches Cilia white. *Hindwing* silky white, with dark brown spot situated in similar positions to those of forewing, but the spo of discal and submarginal series lunular in shape; a subbas row of four small round black spots, one above, one in, a ell; also a row of three crossing middle of cell, and one below, and a spot below lower end of cell, marginal line. Cilia white.

U, 18 mm. (16). **Upperside**.—*Forewing* black, with a void white spot extending to cell but not to inner margin; men base and this spot and below it bluish. Cilia white. *adwing* black, with brown costal margin and subapical white spot situated between subcostal and second median nervules and extending somewhat into cell, which is bluish. Cilia white.

Underside as in ♂.

I can recognise among very perfect specimens (♂) three shades of blue, one of which shows a trace of purple. I also find in hree inland specimens curious dark patches of scales in the tre of forewing quite different from that of the three wing species, while in a dozen other specimens this is nt. In the female the size of the white spots is very iable, and, when very small, they are usually wholly suffused th blue scales.

It is quite possible that I may have two species in my abinet under this name as represented by males with and without a darker patch on the forewing on upperside; but I must ertainly hesitate to separate them, especially as there are three other species very closely allied. This species is by far the commonest and has the widest range of the four allied forms.

Loc.—Victoria, New South Wales, Brisbane to Cairns (♂ 14, ♀ 12).

CANDALIDES MARGARITA, Semper.

Holochila margarita, Semp., Mus. Godf. Lep. xiv. p. 161, 1878; Druce, P.Z.S. 1902, ii. p. 119.

♂. 16-18 mm. Shape as in *C. absimilis* ♂.

Upperside blue, with uniform jet black outer margins ider and more distinct than in *C. absimilis*; curious, somewhat ised, scales (Semper's arrow-shaped shadow) on median nervules ear lower end of cell. Cilia white.

Underside silky white, with the scheme of markings as in *absimilis*, but with many spots wanting; discocellular spots and discal series in both wings often absent, and generalckhampton ings are less well defined than in *C. absimilis*; three distinct jet black spots on outer margin near anal an of fore except- white.

♀. 14-18 mm. (17). Shape as in *C. absimilis* ♀.

Upperside as in *C. absimilis* ♀, but with the white of hindwing extending to costa.

Underside as in ♂, but the interneural series of black spots extending all along outer margin of hindwing.

This species is intermediate between *C. absimilis* and *C. helenita* in respect of the underside; while on the upperside it shows some characters of both species. The colour of the male is near that of *C. absimilis*, but it has broader margins and also shows t arrow-shaped shadow as in *C. helenita*; the female has the b bases of *C. absimilis*, and the white patch extending to cost hindwing. Semper's description and Druce's figure of the female of *C. helenita* clearly show that that specimen is really female of this species and not *C. helenita* ♀, which has no blue the upperside, and is almost without markings below.

Loc.—Cairns, Gayndah, Cape York (♂ 2, ♀ 6).

CANDALIDES HELENITA, Semper (Plate ii., fig. 34).

Holochila helenita, Semp., Mus. Godf. Lep. xiv. p. 162, 1878; Druce, P.Z.S. 1902, ii. p. 119; Waterhouse, Proc. Linn. Soc. N. S. Wales, 1902, p. 333: *H. androdus*, Misk., Proc. Linn. Soc. N.S. Wales, 1890, p. 41: *H. subargentea*, G. Smith & Kirby, Rhop. Exot. pt. 38, figs. 9, 10, 1896.

♂. 15-17 mm. (16). Shape as in *C. absimilis* ♂.

Upperside greenish-blue, with very narrow dark oute margins and the arrow-shaped shadow made by the raised scale on median nervules in forewing. Cilia brownish.

Underside silky white, with an interneural series of blac spots on outer margin of hindwing, rest of wings usually withou markings, though a careful examination will sometimes reve faint traces of discal and submarginal series. Cilia white.

♀. 12-18 mm. (16). Shape as in *C. absimilis* ♀.

rside black, with a large central white spot on fore-aching nearly to inner margin; a large spot on hindwing ching costa, *no blue scales near bases.* Cilia white.

Underside as in ♂.

This species may be recognised by the greenish colour of the male, and the absence of blue in the female on upperside; and the want of markings on the underside.

Semper's description and Druce's figure of the female refer to *margarita* ♀. It may be argued that these species are not istinct, but no one will assert that *C. absimilis* and *C. helenita* e the same; then comes the difficulty to which species we ust assign *C. margarita* as it possesses some of the characters of both, rendering such a course impossible. Twenty-five years ago Semper was able to discriminate between the three males, and his remarks are clearly borne out by the large series Mr. R. E. Turner has collected in N. Queensland. Semper unfortunately only possessed females of two species, and as a result assigned the wrong female to *C. helenita.*

Loc.—Cairns to Cape York (♂ 3, ♀ 7).

CANDALIDES GILBERTI, n.sp.

♂. 15 mm. *Forewing* with apex more acute and outer margin straighter than in the three allied species. *Hindwing* with outer rows in rounded.

pperside pale violet-blue with linear dark outer margins. ilia white.

Underside.—*Forewing* white, with an elongate black spot at end of cell, a discal row of six black interneural spots, a dark ubmarginal line, and a faint indication of dark marginal dots. ilia white. *Hindwing* white, with four round jet black subbasal pots, the second in cell; four transverse spots crossing middle of ell; first above cell, elongate; second in cell, a black discocellu-r streak, a curved discal series of seven black spots, the second ing much nearer base than the rest, a submarginal wavy ack line, a marginal interneural series of black spots. Cilia hite.

♀. 17 mm. Shaped as in ♂ rather than like *C. absi*. terminal joint of palpi very long.

Upperside.—*Forewing* pale blue, with costal margin bla e except towards base, apex broadly and outer margin black, white streak from end of cell to near outer margin. Cilia white. *Hindwing* blue, with a brownish costal margin and a black narrow outer margin widest at apex, a whitish patch between subcostal nervure and nervule. Cilia white.

Underside.—*Forewing* with discocellular spot almost obs lete, a black outer marginal line, submarginal line broken, othe wise as in ♂. *Hindwing* as in ♂, with subbasal spots smalle and outer marginal spots very distinct, that near anal angle large and jet black.

I have described this species from a single pair taken at Port Darwin by Mr. Gilbert Turner during last November; neither specimen unfortunately is quite perfect, but they are sufficiently free from rubbing to show that they are quite distinct from anything yet known from Australia.

The undersides are much more distinctly marked, especially with regard to the discal series, than *C. absimilis*; and it should be noted that the second spot of the discal series of hindwing is much nearer base than first.

On the upperside the male is nearest *C. absimilis*, but m paler; as to whether the arrow-shaped sexual mark is present is difficult to say, as the male is rubbed at that point, but it apparently is there; the female is markedly distinct from the females of the three allied species, and seems to occupy a positio intermediate between *C. absimilis* (♂ ♀) with white areas muc reduced. This species tends to show further that the group, a typified by *C. absimilis*, is very varied; and that we have her four variations of a much older species. A similar state of thing centres around *Miletus ignita*, though there the different form cannot be so clearly picked out as in the *C. absimilis* grou (♂ 1, ♀ 1).

CANDALIDES ALBOSERICEA, Miskin (Plate ii., figs. 24-25).

Holochila albosericea, Misk., Syn. Cat. Rhop. Aust. p. 65, 1891.

♂. 15-16 mm. Upperside shining white, with a slight greyish-blue basal suffusion, and a black tip to apex of forewing. Cilia brown.

Underside uniformly brown without markings.

♀. 15-16 mm. Upperside bluish-white, slightly darker at base, apical ¼ of forewing black, decreasing along outer margin to near angle, outer margin of hindwing cloudy. Cilia brown.

Underside uniformly brown without markings.

This is one of the most remarkable of Australian *Lycaenidæ* being quite destitute of markings below, and on the upperside reminding one of the Pierid genus *Elodina*. I think that in the future this species will have to be separated from *Candalides*; though it has a similar neuration, the antennæ are remely short, being about ⅛ length of costa. *Holochila cæ- olactea*, described by Dr. Lucas in a newspaper in Brisbane ng 1891, is probably this species, but newspaper descrip- cannot be allowed to stand. Miskin gives Expedition near Rockhampton as the locality for this species, but other specimens have come from Stradbroke Island, More- ay (♂ 3, ♀ 2).

CANDALIDES ERINUS, Fabricius (Plate ii., figs. 17-18).

Pap. erinus, Fabr., Syst. Ent. p. 525, 1775; Don., Ins. New Ioll. t. 31, f. 3, 1805; Semp., Mus. Godf. Lep. xiv. p. 162, 1878: *Polyommatus subpallidus*, Lucas, Proc. Roy. Soc. Qsld. vi. p. 117, t. 6, f. 1-2, 1889.

♂. 11-14 mm. (12). Upperside shining brown, with a slight purplish reflection, black outer margins much broader at apex of forewing. Cilia white.

Underside.—*Forewing* greyish-white, discocellular bar if present very faint; discal band of interneural brown spots almost straight, beyond which the wing is much whiter; submarginal series of indistinct dark spots, of which the two towards angle are very large, round, and black, a black marginal line. Cilia white. *Hindwing* greyish-white, four subbasal small dark dots, second in cell; four crossing middle of cell, second in cell; a discocellular streak, below which is another spot, a curved discal interneural series of wedge-shaped brown spots; submarginal series of indistinct wavy spots, often with a marginal series of blotches; a dark marginal line. Cilia white.

♀. 11-14 mm. (13). Upperside uniform dull blackish brown, sometimes, though rarely, showing a basal bluish tint. Cilia white.

Underside as in ♂.

I have experienced great difficulty with this and the three following species which Miskin considered to be all the same. Druce* says that this is the small form, and the next species the large form of *C. erinus*, a statement which I hope to show is incorrect. The difficulty begins with the doubt as to which v
the type of Fabricius, who described the wings as "supra fu
subtus cinereæ." Butler in his paper on the Fabrician ty
states that the type is a female; this then must refer to
northern form (*subpallidus*) and not to the southern (*hyacin*
This view is further borne out by Donovan's figure which,
taken from the type, leaves no doubt that the type of *C.*
is the same species Dr. Lucas subsequently described as *P.*
pallidus.

I have tabulated the differences of this and the next species.

	C. erinus.	*C. hyacinthina.*
Average size	♂12mm. ♀13mm.	♂14mm. ♀15mm.
Costa of forewing	arched	nearly straight.
Apex	blunt	acute.
Outer margin of forewing (♂)	convex	straight.
Cilia	white	greyish.
Upperside (♀)	dull brown	purple.
Underside	greyish-white	grey.

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* P.Z.S. 1902, ii. p. 120.

♀. 10-13 mm. (12). Shape as in *C. erinus* ♀.

Upperside dark brown, with centrobasal areas rich purple, of very variable extent. Cilia white, spotted with brown.

Underside as in ♂, but sometimes with the addition of two black spots in cell of forewing.

This species is of the size and shape of *C. erinus;* and of the colouration of *C. hyacinthina* on the upperside, but is quite distinct from both on the underside, being darker, the wedge-shaped spots being replaced by black dots, and the two black spots of forewing being represented only by dark suffusions.

It is found in the same localities and at the same time of the year as *C. hyacinthina,* otherwise it might easily be supposed to be a seasonal form of that species. Druce has shown that *C. maerens* must sink under *C. anita;* and an examination of Miskin's type of *C. canescens* from Tasmania, which is in rather poor condition, leaves no doubt as to this name having to sink.

Cox thus describes his species: "Expanse 10 lines. Dark inky purple shot with copper colour. Underside grey, with several rows of indistinct brown spots. A large indistinct brown blotch near anal angle of both wings. Fringe unspotted." This, though a very poor description, can, I think, only refer to the species under consideration, which I know is taken in S. Australia, where Cox's type came from. The size he gives is considerably less than what he gives for *C. heathi,* so that it is scarcely likely he refers to *C. hyacinthina,* which is nearly as large as *C. heathi.* I rather doubt Semper's locality of Cape York.

Loc.—Tasmania, South West and South Australia, Victoria, New South Wales (♂ 18, ♀ 8).

CANDALIDES CYPROTUS, Olliff (Plate iii., fig. 4).

Chrysophanus cyprotus, Oll., Proc. Linn. Soc. N.S. Wales, 1885, p. 716: *Hol. cyprotus,* Waterh., Proc. Linn. Soc. N.S. Wales, 1902, p. 333: *Hol. purpurea,* Grose Smith and Kirby, Rhop. Exot. pt. 39, pl. x. figs. 11, 12 ♂, 1896.

♂. 13-18 mm. (15). Upperside.—*Forewing* reddish-brown, with a coppery reflection except on costa, outer margin and nervules; a central purplish-black discal sexual mark. Cilia black, interneurally tipped with grey. *Hindwing* reddish-brown, with a coppery reflection except on costa, outer and abdominal margins; base suffused with purplish-black. Cilia as in forewing.

Underside.—*Forewing* light brown, a discocellular dark streak, discal and submarginal series of interneural blackish spots. Cilia greyish. *Hindwing* light brown, dark spot in cell, central, discal and submarginal curved series of spots, innermost being less extensive. Cilia greyish, spotted with brown.

♀. 14-20 mm. (16). Upperside bright purple, with orange-brown costal and outer margins. Cilia as in ♂.

Underside as in ♂.

In some specimens the spots of the underside are as many as in *C. hyacinthina;* in others the underside is almost without spots. I have already shown that *H. purpurea* is a synonym of this species, which is very distinct from all others of the genus. Specimens bred by Mr. Illidge, near Brisbane, are much larger than Sydney specimens.

Loc.—Sydney, Katoomba, Brisbane to Rockhampton (♂ 18, ♀ 7).

PHILIRIS, Röber.

Tijdschr. Ent. xxxiv. p. 317; Exot. Schmett. Theil ii p. 273, 1892; Druce, Ann. Mag. Nat. Hist. xi. p. 14, 1897.

This genus, the type of which is *P. ilias* from Amboina, has a three-branched subcostal to the forewing, and the costal nervure is entirely free from the first subcostal, but is bent towards it. It is closely allied to *C. xanthospilos*, but has an acute apex and a straight outer margin to the forewing, and the outer margin of hindwing is not nearly so evenly rounded. There is also a great resemblance to *Pseudodipsas*.

The Australian species may be recognised thus:—

A. Underside white, with black spot on abdominal margin of hindwing.
  a. Upperside without white areas........ .... *innotatus*.
  b. Upperside with white areas in both sexes..................... *kamerunga*.

B. Underside white, without black spot on abdominal margin of hindwing.
  a. Upperside in ♂ with forewing purple, hindwing blue; in ♀ both wings blue.. *kurandæ.*
  b. Upperside pale silvery blue. .... *nitens.*

PHILIRIS INNOTATUS, Miskin (Plate iii., fig. 2).

Pseudodipsas innotatus, Misk., Ent. Mo. Mag. 1874, p. 165: *P. innotatus*, Druce, P.Z.S. 1902, ii. p. 115: *Pseud. ilias*, Misk., (nec Feld.), Syn. Cat. Rhop. Aust. p. 67, 1891: *P. ilias*, Waterh., (nec Feld.), Proc. Linn. Soc. N.S. Wales, 1902, p. 652.

♂. 12-15 mm. (13); ♀. 12-15 mm. (13).

This species may be recognised by the purple upperside in the male, and the brown upperside with pale blue centrobasal area to forewing in female; on the underside both sexes are silky white, with a small black spot on abdominal margin. My males from Cape York have the dark borders on the upperside more developed and consequently the purple areas more restricted. In my former note I expressed a little doubt as to whether our species was synonymous with *P. ilias*, Felder, from Amboina; Druce has since shown that our insect is distinct.

Loc.—Richmond River to Cape York (♂ 9, ♀ 10).

PHILIRIS KAMERUNGÆ, Waterhouse.

Proc. Linn. Soc. N.S. Wales, 1902, p. 650.

. 12 mm.; ♀. 12-13 mm.

his species may be recognised by the white areas in both on both wings; on the upperside these areas are very vari- ut always smaller in ♂ than in ♀.

—Cairns, Q. (♂ 1, ♀ 3).

PHILIRIS KURANDÆ, Waterhouse.

nn. Soc. N.S. Wales, 1902, p. 651.

mm.; ♀. 14-16 mm.

underside of both sexes being silky white without markings. *Holochila fulgens*, figured by Grose Smith & Kirby,* is an allied species.

Loc.—Cairns, Q. (♂ 3, ♀ 3).

PHILIRIS NITENS, Grose Smith.

Hol. nitens, G. Smith, Nov. Zool. v. p. 107, 1898; G. Smith & Kirby, Rhop. Exot. pt. 49, 1899.

"♂. Upperside.—*Forewing* dull brown, with a basal pale silvery blue area extending along inner margin to three-quarters its length, extending obliquely upwards to the lower part of the cell and over the base of the two median nervules. *Hindwing* with the basal four-fifths pale silvery blue, the outer one-fifth being dull brown.

Underside white. The apex of forewing and angle of hindwing acuminate, as in *H. fulgens*.

Hab.—N. Queensland. Exp. 1⅛ in."

The above is the description from the 'Rhopalocera Exotica'; the figure is rather purple than silvery-blue and less extensive than in *P. innotatus*, but I still doubt if it is quite distinct from that species: the figure is slightly smaller than in average *P. innotatus* ♂ in my collection.

PSEUDODIPSAS, Felder.

Wien. Ent. Mon. iv. p. 243, 1860; (part) Hew., Trans. E Soc. Lond. 1874, p. 343.

Forewing with a three-branched subcostal, first branch free from costal. Costa, outer and inner margins straight outer margin convex in ♀, apex very acute in ♂. *Hi* rather produced at anal angle, with three very short tail- jections, quite different from those of *Lycænesthes. sone*, Felder.

This genus is allied to the *C. absimilis* group of the main points of difference being the straighter outer margins, the more acute apex of forewing in ♂, and the produced, slightly tailled hindwing; the palpi are shorter in both sexes.

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* Rhop. Exot. pt. 39, 1897.

I can recognise three Australian species as clearly belonging to this genus, and have included a fourth which appears to be best placed here, though it has a slightly different neuration and shape.

The species may be thus distinguished :—

A. Upperside of both sexes above blue, below grey	*digglesi.*
B. Upperside of ♂ black; of ♀ brown, with outer ⅓ of hindwing yellow, underside whitish	*eone.*
C. Upperside of both sexes black, with centrobasal blue areas usually on forewing only, underside white	*fumidus.*
D. Upperside brown, with basal blue areas in ♀, underside brown	*brisbanensis.*

PSEUDODIPSAS EONE, Felder (Plate ii., figs. 14-15).

Wien. Ent. Mon. iv. p. 243, 1860; Reise, Nov. Lep. ii. p. 258, t. 32, f. 8, 9, 1865; Semp., Mus. Godf. Lep. xiv. p. 164, 1878.

♂. 12 mm, Upperside.—*Forewing* black, with a faint purplish sheen. *Hindwing* black, with a faint purplish sheen, three white submarginal spots between submedian nervure and first, second and median nervules; an interrupted marginal white line. Cilia white. Long white hairs on abdominal fold.

Underside.—*Forewing* silvery white, with pale brown markings; one dark subbasal brown spot in cell, below which external to cell is another dark spot; a light brown oblong spot in middle of cell, and a similar one at end of cell; a faint short subapical band and a submarginal band of pale brown spots; margin marked with brown, internal to which are brown suffusions. Cilia brown. *Hindwing* silvery white, with pale brown markings; a subbasal row of four brown spots darker than the rest, first above cell, second in cell, third below cell, fourth very close to inner margin; a pale brown spot in middle of cell above and below which are other spots, and one at end of cell; margin defined by a dark brown line, internal to which is a marginal series of lunules, internal to which again is an irregular series of brown lines; between first and second median nervules a black spot, and at anal angle a similar smaller spot, both crowned with orange. Cilia brown.

♀. 13 mm. Upperside.—*Forewing* brown, with faint white cilia. *Hindwing* brown, except for anal portion of outer margin, which is yellow; this yellow patch extending from a little beyond middle of outer margin nearly to anal angle, and inwards for about ¼ length of wing; within the yellow patch two brown triangular spots, between submedian nervure and first and second median nervules; margin marked by a brown line, internal to which is an interrupted white line showing more conspicuously at the triangular brown spots. Cilia white.

Underside as in ♂ except for the difference in shape, and that the subbasal spots are the same colour as the remaining spots.

Felder's figures of both sexes are very good.

Loc.—Cairns to Cape York (♂ 1, ♀, 1).

PSEUDODIPSAS DIGGLESI, Hew.

Trans. Ent. Soc. Lond. 1874, p. 344; Ill. Diurn. Lep. pp. 218, 219, pl. xxxix. f. 1-4, 1878.

♂. 14-17 mm. (16). Outer margin of forewing very straight, tail-like projections of hindwing almost obsolete, but hindwing drawn out at anal angle.

Upperside.—*Forewing* brilliant metallic blue, with brown costal and outer margins, widest at apex; nervules marked with brown. Cilia white. *Hindwing* brilliant blue, with broad brown costal, narrower outer, and pale brown abdominal, margins; subcostal nervure marked with brown. Cilia white.

Underside.—*Forewing* grey, with an elongate brown spot at end of cell, an interneural discal series of brownish spots, a submarginal series of small dark brown spots, the lowest much the largest. Cilia white. *Hindwing* grey, crossed by transverse series of spots; five round, subbasal; one above, *two* in, two below cell; a series of four crossing middle of cell, first narrow above, second and third round, in cell; fourth round, below cell; an elongate spot at end of cell, below which is a round spot; a discal curved series of narrow spots, a submarginal interneural series of orange spots; more or less outwardly bordered with metallic green, a large black spot at termination of first median, a smaller spot at termination of submedian. Cilia white.

♀. 14-18 mm. (17). Outer margin of forewing not nearly so straight as in ♀. Outer margin of hindwing much rounder.

Upperside pale blue, centrobasal areas with very broad brown costal and outer margins, pale brown abdominal margin, nervules of both wings marked in brown. Cilia white.

Underside.—*Forewing* grey, spots as in ♂ with the addition of a small brown spot in cell towards its end; submarginal series sometimes orange, sometimes faintly bordered outwardly with metallic green. Cilia white. *Hindwing* as in ♂, with submarginal orange series better developed, also more metallic scales, dark terminations to all the median nervules.

This magnificent insect nearly equals the metallic blue *Ogyris* in splendour. It appears to vary very much in size but very little in colour; and I have seen some splendid specimens bred by Mr. F. P. Dodd at Townsville.

Loc.—Brisbane to Cape York (♂ 4, ♀ 3)).

PSEUDODIPSAS FUMIDUS, Miskin (Plate ii., figs. 12-13).

Proc. Roy. Soc. Qsld. vi. 1889, p. 264.

♂. 11-13 mm. (12). Upperside.—*Forewing* glossy black, with a metallic blue patch on basal half of inner margin extending up to but not into cell, often much reduced in size so as to be nearly obsolete. Cilia short, brownish. *Hindwing* glossy black, with a narrow interneural whitish line on outer margin and two large jet black spots crowned with bluish. Cilia white.

Underside.—*Forewing* silvery grey, marked with darker brown spots, first in cell subbasal, another below this external to cell, one elongate in middle of cell, an elongated spot outside cell below this, one large marking end of cell, below which another; a rather broad discal series from costa to subgrcomes

ding nearly

submarginal linear band. Cilia brown. *Hindwing* silvery grey with brown spots, four subbasal, of which 2nd and 3rd are in cell, a fifth spot on abdominal margin, an elongate spot in middle of cell above and below which external to cell is another spot, a spot near costa at middle, a broad curved costal series, a submarginal lunular series, a small black spot near anal angle nearly surrounded with orange, another on margin between first and second medians, a brown marginal line internal to which is a white line and then a series of brownish blotches. Cilia brown.

♀. 11-14 mm. (13). Upperside.—*Forewing* black, with pale blue scales very variable in extent, sometimes only occupying a small basal area between median and submedian nervures, at others occupying ¾ of wing, leaving only a black costal and outer margin and a dark spot at end of cell. Cilia brown. *Hindwing* brownish-black, with a white interneural almost marginal line, a submarginal series of bluish lunules which with the white line enclose darker spot-like areas, cell often with a very small splash of metallic scales, rarely a blue suffusion over most of wing. Cilia white.

Underside as in ♂, except that the spots are more distinct and the subbasal spot in cell of forewing is often split up into two.

This is a very variable species, the type male apparently having more blue than any male I have seen; but this is not surprising, as the three males in my collection all vary in that direction, but usually the female has more blue than the male. As in several other of our *Lycænidæ*, the male is much the rarer.

Loc.—Richmond River, N.S.W., to Cairns, Q. (♂ 3, ♀ 6).

PSEUDODIPSAS BRISBANENSIS, Miskin.

Trans. Ent. Soc. Lond. 1884, p. 95: *Lyc. cyrilus*, And. & Spry, Vict. Nat. 1897, pp. 5-7.

♂. 12 mm. *Forewing* with costa and outer margin straight, apex acute; three subcostal nervules, 1st entirely free from l, upper discoidal given off from subcostal well after and nd of cell as in the other three species. *Hindwing* somewhat produced but not so distinctly tailled as in the species.

Upperside uniform shining brown, with dark outer n ginal lines; hindwing with two black spots near anal ang separated from black marginal line by a pale blue line. Cili brown.

Underside.—*Forewing* brown, with slightly darker spots and bands faintly margined with white, 1st in cell subbasal, 2nd in middle of cell long, below which external to cell is another, an elongated spot at end of cell, a spot below lower angle of cell, a transverse discal series and a submarginal series of dots. Cilia brown. *Hindwing* brown, crossed by darker bands and spots, a subbasal row of three, above, in middle of, and below cell, a row of four crossing middle of cell, two above, one elongate in middle, one below cell, an elongate spot at end of cell, below which is another; a curved discal series, and a submarginal row of dark lunules; two black spots near anal angle crowned with orange and separated from outer margin by a white line. Cilia brown.

♀. 11-15 mm. (13). Outer margin of forewing convex. Hindwing somewhat quadrate.

Upperside.—*Forewing* smoky black, with a dark spot at end of cell, centrobasal area between subcostal and inner margin blue, in some specimens much restricted. Cilia brown. *Hindwing* smoky black, with centrobasal area between subcostal and submedian usually but not always suffused with blue scales, two (sometimes three or four) black spots on outer margin near anal angle, often crowned above with blue and separated from outer margin by a blue line which extends along outer margin. Cilia brown.

Underside as in ♂, but often with an outer marginal band of rather obscure orange spots on the hindwing.

Loc.—Victoria, Sydney, Brisbane.

I have a female in which the outer margin of hindwing comes down straight from apex to 1st median, and then, turning nearly

ght angles, runs to the anal angle; in another female th
margin is rounded.

Miskin's type is a very large female, and is rather more highly
loured than southern specimens; but from an examination o
it, I am certainly of opinion that the Victorian species is th
same. Mr. Illidge has compared my specimens with the type and they are almost identical on the underside (♂ 1, ♀ 6).

LYCÆNESTHES, Moore.

P.Z.S. 1865, p. 773; Trimen, South Afr. Butt. ii. p. 93, 1887 de Nicév., Butt. Ind. iii. p. 127, 1890.

In this genus, the type of which is *L. emolus*, Godt., (*L. bengalensis*, Moore) there are three subcostal nervules, the first being entirely free from the costal nervure. On the hindwing there are three highly ciliated short tail-like appendages from the submedian nervure and the 1st and 2nd median nervules; these cilia are very often broken off in cabinet specimens.

The genus is somewhat allied to *Nacaduba*, and has a somewhat similar scheme of markings on the underside. Miskin lists five species in his Catalogue, of which *L. turneri* must sink under *L. godeffroyi*, and *L. phaseli* (as determined by Miskin, not of Mathew) is possibly the same insect as Semper records under *L. balliston*. *L. hypoleuca*, Prittw., I have placed among reputed Australian species, for reasons I will discuss later; it most certainly would not come into this genus. *L. tasmanicus*, Misk., is the male of the insect recorded by Semper as *Lam. palmyra*, Feld., which is certainly very distinct from *N. lineata*, Murray, and should be placed under *Nacaduba*.

The species may be recognised as follows:—

A. ♂. Apex of forewing and outer margin of hindwing rounded; upperside dull purplish-blue.......... *emolus*.
B. ♂. Apex of forewing acute, outer margin of hindwing nearly straight.
  a. ♂. Bright purplish-blue.......... *modestus*.
  b. ♂. Lilac-blue.......... *godeffroyi*.

The general pattern of the underside is as follows:—

Underside.—*Forewing* brown or grey, with a slightly darker spot bordered with white at end of cell, a discal series of similar spots from near costa to submedian; an outer marginal lunular band, internal to which is a brownish band of suffusions; a dark marginal line. *Hindwing* concolorous with forewing, crossed by similar spots; a subbasal row of three crossing middle of cell, one elongate marking end of cell, a curved discal row from costal nervure to inner margin; outer marginal lunular band as in forewing; a jet black spot on margin between first and second medians, crowned with orange; a dark marginal line, three short tails to first and second medians and submedian composed of a few lengthened cilia.

LYCÆNESTHES EMOLUS, Godart.

Poly. emolus, Godt., Enc. Méth. ix. p. 656, n. 133, 1823: *Lycæn. emolus*, de Nicév., Butt. Ind. iii. p. 128, 1890: *Lam. balliston*, Hübn., Zutr. Exot. Schmett. figs. 229, 230, 1823: (?) *Lam. balliston*, Semp., Mus. Godf. Lep. xiv. p. 165, 1878: *L. bengalensis*, Moore, P.Z.S. 1865, p. 773, pl. xli. fig. 9.

♂. 15 mm. *Forewing* with costa gently arched, apex rounded, outer margin slightly convex, inner margin straight.

Upperside dull purplish-blue, with a dark marginal line; costal and abdominal margins of hindwing brown, an indistinct black spot at anal angle, three finely ciliated white tails. Cilia brown.

Underside brown, spots slightly darker brown bordered with white, situated as in general description, a splash of orange between jet black marginal spot and anal angle; a *small black spot* on abdominal margin towards base. Cilia brown.

♀. Upperside pale purplish-brown, with a suffused bluish patch at base; outer margins suffused with darker brown. *Hindwing* with an inner narrow white outer marginal line.

Underside.—Both wings as in ♂.

This species may be recognised by the rounded apex of forewing, and outer margin of hindwing. In spite of the Australian records of de Nicéville and Druce* for this species, I always supposed they referred to the next species, until I received a single male from Mr. Lower, which agrees exactly with the various descriptions of *L. emolus*, and also with an Indian specimen (♂) in the Macleay Museum.

LYCÆNESTHES MODESTUS, n.sp. (Plate iii., fig. 38).

L. phaseli, Misk., (nec Math.), Syn. Cat. Rhop. Aust. p. 59, 1891.

♂. 12-15 mm. (14). *Forewing* with costa nearly straight, apex acute, outer margin straight.

Upperside shining purplish-blue, with dark marginal lines; costal and abdominal margins brown; two jet black interneural spots near anal angle, three short white ciliated tails. Cilia brown, white near anal angle of hindwing.

Underside greyish-brown, with slightly darker spots as in general description. A brown spot on abdominal margin near base. Cilia brown.

♀. 12-15 mm. (14). Shape somewhat as in ♂, but outer margin of forewing more convex and outer margin of hindwing rounded.

Upperside brown, slightly darker towards margins, with centrobasal areas suffused with blue. Anal angle with two interneural black spots, crowned with white which sometimes extends further along outer margin; an outer marginal black line to hindwing. Cilia brown.

Underside as in ♂.

This, the commonest of the genus in Australia, has been known as *Lycænesthes phaseli*, but Mr. Druce has clearly shown† that Mathew's *Lampides phaseli* belongs to the genus *Jamides* and so has *one* moderate filamentous tail. Mathew, however, makes no mention of a tail or tails, and his description might well answer for several of the Australian *Lycænidæ*. With reference to *Lyc. lycænoides*, Feld., of which the underside of the male is figured by Felder, and the female by Hewitson, I should certainly say it is not *Lyc. emolus*, Godt., but rather approaches, if it is not identical with, the species herein described.

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* P.Z.S. 1891, p. 358.

† P.Z.S. 1892, p. 443.

Loc.—Mackay to Cape York, Thursday Island (♂ 10, ♀ 6).

LYCÆNESTHES GODEFFROYI, Semper.

Mus. Godf. Lep. xiv. p. 165, 1878 : *L. turneri*, Miskin, Proc. Linn. Soc. N.S. Wales, (2) v. p, 39, 1890; de Nicév., Journ. Bomb. Nat. Hist. Soc. xiii. p. 146, pl. Z, figs. 23, 24, 1898.

♂. 13-14 mm. (14). Shape as in *L. modestus*, but rather more produced at anal angle.

Upperside uniform lilac-purple, with narrow dark outer margins, three short white ciliated tails. Cilia brown.

Underside greyish, with spots and bands as in general description, well bordered with white; colour of spots not markedly different from groundcolour; outer marginal lunular bands well developed. Cilia brown.

♀. 15-16 mm. (15). Shape as in *L. modestus* ♀.

Upperside.—*Forewing* black, with centrobasal area broadly blue, a large white blotch just beyond lower end of cell. *Hindwing* light whitish-violet, the nervules well marked in brown; outer marginal line black, internal to which is an interneural white line, then an interneural series of whitish-violet lunules situated in a broad black outer margin. Cilia white.

Underside as in ♂, but disc much whiter, the white spot of forewing showing on underside.

This species lacks the dark spot on the abdominal margin on underside usually found in *L. emolus* and *L. modestus*, in this particular agreeing with the Indian *L. lycænina*, Feld., to which in several respects the male is allied.

Dr. Staudinger* figures under the name *Pseudodipsas lycænoides*, Feld., a male somewhat allied to this species; and he remarks that he has specimens from Australia which he considers to be varieties of *L. lycœnoides;* but whether he refers to this or the preceding species I am unable to say.

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* Exot. Schmett. p. 273, t. 94, 1888.

Loc.—Mackay to Cape York, Port Darwin (♂ 4, ♀ 2).

POLYOMMATUS, Latreille.

Gen. Crust. et Ins. iv. p. 206, 1809; Moore, Lep. Cey. i. p. 93, 1881; de Nicév., Butt. Ind. iii. p. 203, 1890.

As restricted by Moore and de Nicéville, this genus has the forewing triangular, the subcostal with three branches, the first of which is quite free from the costal nervure; and the hindwing has a long filamentous tail to the first median nervule.

Type *P. bœticus*, Linn.

The genus now comprises one, almost world-wide species, though there seems little to separate it from such a species as *Catochrysops strabo*, Fabr.

POLYOMMATUS BŒTICUS, Linn. (Plate iii., fig. 11).

Pap. bœticus, Linn., Syst. Nat. ed. xii. i. p. 789, 1767 : *Poly. bœticus*, de Nicév., Butt. Ind. iii. p. 204, t. 27, fig. 190, 1890 : *Lampides bœticus*, And. & Spry, Vict. Butt. ii. p. 84, 1894 : *Pap. damoëtes*, Fabr., Syst. Ent. p. 526, 1775; Don., Ins. New Holl. pl. xxxi. fig. 2, 1805.

♂. 12-17 mm. (15). Upperside violaceous, blue at base, with a covering of long bluish hair-like scales, costal and outer margin brown, a round black caudal spot, another at anal angle; tail black, tipped with white. Cilia white.

Underside.—*Forewing* light brown, crossed by linear brown fasciæ margined with white; a straight submarginal white fascia from near apex to submedian. Cilia whitish. *Hindwing* light brown, basal ⅔ crossed by narrow irregular white lines, a broad white straight discal band, caudal and anal spots jet black, sprinkled with metallic green scales, and crowned with orange. Cilia whitish.

♀. 12-17 mm. (15). Upperside light brown with centro-basal areas bluish, of very variable extent, hindwing often with two indistinct submarginal whitish bands, caudal and anal black spots circled with white. Tail black, tipped with white. Cilia white.

Underside as in ♂, but often a spot below cell of forewing.

Papilio coluthea, Fuess., *P. archias*, Cram., and *P. pisorum* are synonyms.

This is a variable and widespread species, but can be easily recognised by the straight white discal fasciæ of the underside. It occurs throughout Australia, and is one of the few *Lycænidæ* that is found up to 500 miles from the coast (♂ 30, ♀ 30).

CATOCHRYSOPS, Boisduval.

Voy. Astr. Lep. p. 87, 1832; de Nicév., Butt. Ind. iii. p. 175, 1890: *Euchrysops*, Butl., Entom. xxxiii. p. 1, 1900.

In this genus the subcostal has three branches, the costal nervure is bent down so as almost to touch the first subcostal but is not anastomosed with it, the hindwing is provided with a filamentous tail to the first median.

Type *C. strabo*, Fabr.

Butler has separated *C. cnejus* and *C. pandava*, placing them in a new genus *Euchrysops*.

A. Hindwing with outer margin nearly straight .... *platissa*.
B. Hindwing with outer margin round .... *cnejus*.

CATOCHRYSOPS PLATISSA, Herrich-Schäffer.

Lycaena platissa, Herr.-Schff, Stett. Ent. Zeit. xxx. p. 74, pl. iv. fig. 20, 1869: *C. platissa*, Druce, P.Z.S. 1891, p. 369: *Lampides kandarpa*, Semper (nec Horsf.), Mus. Godf. Lep. xiv. p. 158, 1878: *Lam. lithargyria*, Moore, Ann. Mag. Nat. Hist. xx. p. 340, 1877: *C. lithargyria*, de Nicév., Butt. Ind. iii. p. 178, 1890: *C. strabo*, auctorum nec Fabr.

♂. 11-15 mm. (13). Shape and neuration nearly as in *P. bœticus*.

Upperside greyish-whitish-blue, with narrow black outer margins, a round jet black caudal spot, a black mark at anal angle; tail filamentous, black, tipped with white.

Underside greyish-white crossed by slightly darker bands well bordered with white. *Forewing* with a short discocellular band, a long curved discal band, often an indistinct spot on costa between these bands, outer marginal lunular bands indistinct. Cilia whitish. *Hindwing* with three subbasal spots, middle one in cell, a short discocellular, a long curved discal band with 1st spot nearer base than 2nd, outer marginal bands indistinct, caudal spot black, crowned with orange, anal spot black. Cilia whitish.

♀. 11-15 mm. (14). Shape as in ♂.

Upperside brown, centrobasal areas blue, variable in extent; outer margin of hindwing with two whitish interneural lunular bands, caudal spot black, crowned with yellow. Cilia whitish. Tail black, tipped with white.

Underside as in ♂.

This species is allied to *C. strabo*, Fabr., indeed the females of the two are said to be identical; the typical lilac-blue male of that species, however, has not yet been recorded from Australia. On the upperside the female very closely resembles *Nacaduba ancyra* ♀.

De Nicéville determined Australian specimens as *C. lithargyria* but that name must give way to *C. platissa*; for Herrich-Schäffer's type (♀) came from Australia, where *C. strabo* does not occur; so that *C. platissa* cannot be a synonym of that species.

Loc.—Brisbane to Cape York, North and North-West Australia (♂ 10, ♀ 3).

CATOCHRYSOPS CNEJUS, Fabricius (Plate iii., fig. 10).

Hesperia cnejus, Fabr., Ent. Syst. Suppt. p. 430, 1798: *C. cnejus*, de Nicév., Butt. Ind. iii. p. 178, 1890: *Lyc. samoa*, Herr.-Schff., Stett. Ent. Zeit. xxx. pl. iv. f. 18, p. 37, and p. 138, 1869.

♂. 11-16 mm. (14). Upperside uniform pinkish-blue, with greyish-brown outer margins, two black spots at anal angle of hindwing. Tail brown, tipped with white. Cilia white.

Underside.—*Forewing* grey, with a darker discocellular spot bordered with white, a discal band of five or six similar spots, outer margin with a double indistinct brownish band.

terminal free portion of the costal is often very difficult to see.

Loc.—South Australia, Victoria, New South Wales, Queensland to Mackay and North West Australia (♂ 40, ♀ 40).

UNA, de Nicéville.

Butt. Ind. iii. p. 51, 1890.

costal three-branched, 1st branch entirely anastomosed stal except a very short free basal portion. Type Distant. The genus, as regards neuration, is allied to The Australian species I place in this genus are only ly referable there; though structurally they are identical, shape of the wings is different. Mr. de Nicéville, who ree of the species, noted them as *Zizera* (?), but then not examined them structurally. I have little doubt ese species will eventually be placed in one or two other (perhaps as yet undescribed), but for the present I e to undertake that task myself, as I know there are ed South African forms which as yet I have had very little portunity of studying. *Prosotas*, Druce, is close to, if not entical with, *Una*, but my acquaintance with these genera only from figures. They appear to be quite tropical forms, hereas all the Australian species are southern forms, one ction being entirely confined to Spencer's Bassian Region.

Our present knowledge of these species is very meagre, which remarkable considering their number if looked for at the right ason. This, I think, is due to their being looked upon as too ommon to be worth catching, a mistake too often made in Australia. All the species appear to have only a single brood during the year, though if this is the case with those species that extend into Queensland I am unable to say. For the three Sydney species my dates are:—*agricola*, 8th Sept. to 6th Nov.; *mathewi*, 22nd Sept. to 10th Nov.; *serpentata*, 20th March to 13th April.

I am able to recognise five distinct species, though subsequent nvestigation may show I am including one or two others which e really specifically distinct, but want of sufficient material with *accurate dates and localities* prevents my recognising more, which may thus be distinguished:—

A. Upperside dark brownish-black, with conspicuously spotted cilia.. *agricola.*
B. Upperside brown.
  a. Dark brown, cilia conspicuously spotted.................... *hobartensis.*
  b. Light brown, cilia faintly spotted............................ *mathewi.*
C. Hindwing with a tail-like projection to first median of hindwing.
  a. Upperside with basal areas broadly blue...................... *se*
  b. Upperside brown, blue almost obsolete........................ *s*

The markings of the underside are of the following typ often coalescing, suffused with white, or otherwise o *Forewing* with a dark spot in cell, a discocellular spot, band from near costa to 1st median or submedian; the all more or less strongly bordered with white, sometim concolorous with groundcolour, the spots then represer double white lines; a submarginal lunular suffusion sometimes light, sometimes dark. *Hindwing* with spots of forewing, one basal usually obscured; a row of three cross middle of cell, centre one in cell; one discocellular, often unit with the curved discal series, which is usually very prominer beyond discal series especially in ♀ a broad white suffusion, su marginal suffusions as in forewing, between median nervules ne margins two v-shaped spots pointing inwards.

Palpi of all the species very hairy; antennæ in ♂ slight longer than ½ costa; in ♀ slightly shorter, ending in a spatulat club.

UNA AGRICOLA, Westwood (Plate iii., fig. 26).

Lucia agricola, Westw., Gen. Diurn. Lep. ii. p. 496, t. 76, f. 4, 1850-2: *Lyc. agricola*, And. & Spry, Vict. Butt. ii. p. 88, 1894 *Cupido agricola*, Tepp., Proc. Roy. Soc. S.A. 1882, p. 29, t. 2, f. 8.

♂. 9-12 mm. (11) *Forewing* with costa straight, apex acute outer margin nearly straight. *Hindwing* with outer margin slightly dentate, not tailed.

Upperside glossy brownish-black, a white costal line on forewing. Cilia white, black at terminations of nervules giving a dentate appearance to hindwing.

Underside with inner areas light brown, outer areas suffused with white, spots darker, as in general description; borders white, lined with black; basal area of hindwing indistinct, a marked white discal patch on hindwing, v-shaped marks black. Cilia as above.

♀. 10-14 mm. (12). Shape as in ♂, with outer margin of forewing more convex.

Upperside brown, paler than in ♂. Cilia as in ♂.

Underside as in ♂, markings and borders more decided.

This marked little species apparently has only a single brood early in the season, though Anderson and Spry record it from Victoria in March; I must, however, doubt this, for during the last twelve years I have caught many hundreds near Sydney, but none later than November. It appears to be a coastal species, though I have taken it up to fifty miles inland from Sydney. Olliff* records it from Mt. Kosciusko, but if the specimen in the Australian Museum with that locality attached is the one in question, I believe it to be referable to *U. hobartensis* rather than to this species.

Loc.—South Australia, Tasmania, Victoria, New South Wales, Brisbane (Illidge) (♂ 50, ♀ 30).

UNA HOBARTENSIS, Miskin.

Lyc. hobartensis, Misk., Proc. Linn. Soc. N.S. Wales, 1890, p. 38.

♂. 9 mm. Shape as in *U. agricola* ♂.

Upperside brown, with chequered cilia.

Underside light brown, with darker spots as in general description, but the white borders almost obsolete; spots and bands of hindwing well defined, not obscured as they usually are in *U. agricola;* white discal patch not so prominent as in *U.*

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* Proc. Linn. Soc. N.S. Wales, 1889, p. 623.

agricola; a submarginal row of spots present without v-shaped marks. Cilia as on upperside.

The type in the Miskin collection is a female, which only differs from the male in having the markings better defined on the underside, and with white borders. This species is, I think, without doubt the mountain form of *U. agricola.* Mr. G. Lyell has a female, no doubt referable to this species, from Mt. Erica, Vic., (4,500 ft.), caught in February; it is rather darker on the upperside, but the groundcolour of the hindwing below is white, with the markings almost black. The specimen recorded as *U. agricola* from Mt Kosciusko (5,500 ft.) is, I am sure, this species; it is rather devoid of markings below. Dr. A. J. Turner took two specimens on the summit of Mt. Wellington, Tas., during March, one of which is in my collection. This must be considered a rare species, as I have seen only six specimens (♂ 4, ♀ 2), but it may have been passed over in the field as *U. agricola.*

UNA MATHEWI, Miskin (Plate ii., fig. 9).

Lyc. mathewi, Misk., Proc. Linn. Soc. N.S. Wales, 1890, p. 38

♂. 9-12 mm. (10). Upperside light brown, with darker outer margins, slightly raised scales on nervules crossing disc of forewing. Cilia greyish, only slightly spotted.

Underside with lighter brown spots and bands as in general description, but sometimes almost obsolete, v-shaped marks black, crowned with yellowish, orange or wanting. Cilia light brown.

♀. 9-12 mm. (10). Shape much as in ♂.

Upperside light brown. Cilia rather more marked than in ♂.

Underside as in ♂ but paler, with the areas external to discal bands usually suffused with whitish, especially in hindwing.

I have little doubt from the position assigned by Semper to *L. sylvicola,* Leach, MS., between *agricola* and *labradus,* and the locality Sydney, that this species is intended, but *sylvicola* is a *nomen nudum* as far as I can ascertain. This little species has only been taken in the neighbourhood of Sydney (♂ 35, ♀ 24).

UNA SULPITIUS, Miskin (Plate ii., fig. 21).

Lyc. sulpitius, Misk., Proc. Linn. Soc. N.S. Wales, 1890, p. 37 : *Lyc. serpentata*, Semp., (nec Herr.-Schff.), Mus. Godf. Lep. xiv. p. 159, 1878.

♂. 8-10 mm. (9). Upperside blackish-brown, darker at bases where there is a bluish reflection. Anal angle with two obscure dark spots, outer often crowned with white. Cilia brown, in hindwing slightly chequered.

Underside brown, with slight yellowish tint; spots and bands, as in general description, represented by double parallel white lines, often in forewing with two small white spots on costa and a spot below middle of cell, two conspicuous black spots near anal angle. Cilia brown.

10 mm. Upperside as in ♂, with basal area slightly
three whitish lunular spots near anal angle. Cilia more
red than in ♂.

erside as in ♂, the white markings broader.

ove description is taken from specimens caught near
n May, by Mr. Illidge. It will be noticed that in these
yond discal band of hindwing below is not suffused
. Mr. R. E. Turner has sent me four specimens from
caught in November; they are smaller, and have the
in of forewing more convex; on the underside the white
re broader, and enclose areas darker than the ground-
areas beyond discal bands being slightly suffused with

ecies has been often confounded with *U. serpentata*,
rrich-Schäffer states is blue above and allied to *N.*
= *N. dion*) below, which is clearly not this form.
ys *serpentata* has no blue above, showing that he was
to *sulpitius* and not true *serpentata;* the types of both
species came from Rockhampton. This cannot be a local
U. serpentata, as typical forms are caught in the same
; nor do I think it can be a seasonal form of *U. serpentata.*

—Brisbane to Cooktown (♂ 7, ♀ 2).

UNA SERPENTATA, Herrich-Schäffer.

Lyc. serpentata, Herr.-Schff., Stett. Ent. Zeit. p. 74, n. 32, 1869; And. & Spry, Vict. Butt. p. 88, 1894 : *Cupido molybdena*, Guest, Trans. Roy. Soc. S.A. iv. p. 36, 1882 : *C. fasciola*, Tepper, Trans. Roy. Soc. S.A. iv. p. 30, t. 2, f. 13, 1882.

♂. 9-11 mm. (10). *Forewing* with costa nearly straight, apex blunt, outer margin somewhat convex. *Hindwing* rounded, with a small tail-like prolongation to 1st median.

Upperside slaty brown, with pale purplish-blue centrobasal areas of variable extent always occupying ½ wing, two anal spots usually indistinct, with one to three subanal whitish lunules. Cilia white, markedly spotted.

Underside slaty brown, with spots very little dar markedly bordered with white, discal area of hindwing with white, anal spots often obsolete. Cilia as above.

♀. 9-12 mm. (11). Upperside as in ♂, but colour paler blue and less extensive.

Underside as in ♂, with white suffusions more

Herrich-Schäffer says his species has blue above, a to *N. perusia* below; yet Semper corrects him by say has no blue above, thus showing Semper was referring *pitius* and not to this species. *C. fasciola* and *C. mol* undoubtedly synonyms. *L. palemon*, Cram., a Sout species, has been recorded from Melbourne by Butler;[*] men is without doubt this species, which is close to African species; Trimen,[†] however, made enquiries, letter from Butler to Trimen it is pointed out that the was distinct from the South African form.

Loc.—Every part of Australia except the extreme localities being North West Australia, South Australia Sydney, Richmond River and Brisbane (♂ 40, ♀ 15).

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[*] Ann. Mag. Nat. Hist. 1882, p. 85.

[†] South African Butt. ii, p. 68, 1887.

UTICA, Hewitson.

Ill. Diurn. Lep. p. 56, 1865.

Forewing with costa nearly straight in ♂, slightly arched in ♀, apex acute, less so in ♀, outer margin straight in ♂, slightly convex in ♀, inner margin straight. Subcostal nervure with *three* branches, 1st anastomosed with costal nervure except for a very short basal portion; 2nd given off close to 1st, 3rd nearer apex than end of cell, subcostal ending just above apex, costal ending on costa well beyond end of cell; upper discoidal given off before end of cell, running straight to outer margin, lower discoidal from end of cell; discocellulars in a straight line; 2nd median given off much nearer end of cell than to 1st, 1st and 2nd running straight to outer margin; submedian nearly straight. *Hindwing* with costa much arched basally, then straight, apex round, outer margin nearly straight, with a short tail to 1st median nervule, inner margin slightly convex. Costal nervure much arched at base, ending close to apex; 1st subcostal emitted at ¼ before end of cell; discoidal nearly straight; upper discocellular very oblique, straight; lower discocellular upright, straight; 1st median emitted at ¼ before end of cell, 2nd median almost at end of cell; submedian straight; internal slightly bent, long. *Antennæ* ½ length of costa, distinctly ringed with white, ending in a spatulate club. *Palpi* longer in ♀, 2nd joint long, hairy, 3rd joint short. Eyes small, hairy. Type *U. onycha*, Hew., (=*L. miskini*, Luc.). Hewitson only described this genus from a female specimen in a line or two.

The genus is closely allied to *Nacaduba*, but in that genus the 1st subcostal and costal separate again before reaching costa. The single tail to the hindwing is very different from the filamentous tail as in *Lampides*, *Nacaduba*, &c., being shorter, and highly ciliated at base and along both sides, giving a blunt appearance to it.

I am able to recognise two distinct species that should be placed in this genus.

A. ♂. Upperside brown, with a bluish suffusion.
  a. Two black anal spots, basal half of hindwing on underside light brown........................ *onycha.*
  b. No anal spots, basal half of hindwing on underside dark brown..... .... *onycha* var. *atrosuffusa.*
B. ♂. Upperside purplish-brown; ♀ with a white spot in centre of forewing........................ *scintillata.*

UTICA ONYCHA, Hewitson (Plate iii., figs. 14, 39).

Ill. Diurn. Lep. p. 53, t. 24, f. 11, 12, 1865; Herr.-Schff., Stett. Ent. Zeit. 1869, p. 72; Semp., Mus. Godf. Lep. xiv. p. 166, 1878; Druce, P.Z.S. 1902, ii. p. 116 : *Lyc. miskini*, Lucas, Proc. R. Soc. Qsld. 1889, p. 158, f. 5, 6, 7 : *Theclinesthes eremicola*, Pagenst., Zoologica, xxvii. p. 123, pl. ii. fig. 9, 1900.

♂. 11-16 mm. (14). Upperside brown, covered with lilac-bluish scales except on outer margins and costal margin of hindwing; dark blue basally; a dark round caudal spot to hindwing more or less bordered with white, and sometimes on either side often extending well along outer margin, further interneural dark spots more or less bordered with white. Tail short, highly ciliated, black, tipped with white. Nervules more or less marked with brown. Cilia whitish.

Underside.—*Forewing* some shade of brown, usually pale, with spots often of same shade as groundcolour, often darker brown, bordered on both sides more or less prominently with white; 1st in middle of cell often represented by two parallel white lines, or sometimes a spot extending below cell, a small spot sometimes above it on costa; 2nd at end of cell, often with a spot above it on costa; discal band from costa sometimes to 1st median, sometimes to submedian; a submarginal whitish lunular interneural band often obscure, a dark marginal line; base of wing sometimes showing greyish scales. Cilia whitish. *Hindwing* concolorous with forewing; spots similar to forewing consisting of a subbasal band of three crossing middle of cell, one elongated at end of cell, a discal curved band, bent at anal angle; a submarginal lunular band, a whitish suffusion very often between middle of discal band and outer margin; a jet black anal spot crowned with white, a jet black caudal spot crowned with yellow, orange or orange-red; a dark marginal line. Cilia whitish.

♀. 12-15 mm. (14). Upperside with costal and outer margins broadly brown, centrobasal areas blue, in which the nervules are usually marked with brown. On hindwing a submarginal interneural series of white lunules, sometimes only confined to anal angle. A dark caudal spot. Cilia white, slightly brown at terminations of nervules. Tail as in ♂.

Underside brown, usually darker than in ♂, with spots and bands as in ♂, but much better defined and usually with much wider white borders. Caudal and anal spots as in ♂, but larger. In some specimens white suffusions present beyond discal bands in both wings; and in one specimen, with the exception of band and spots, nearly the whole of hindwing suffused with white.

This species was described and figured by Hewitson from a female specimen; his figure represents a form which is rather the exception than the rule. Semper was the first to describe the male, and the remarks of these early entomologists leave no doubt in my mind that Lucas' species is the same. Druce has pointed out that *T. eremicola* is a synonym.

This species, which bears a superficial resemblance to *Poly. bœticus*, is one of the most variable of our Australian *Lycænidæ*, it being very difficult to get two specimens exactly alike. Sydney specimens are much paler and more suffused on the underside than those from Mackay, while those from N.W. Australia are also paler, but they are not much suffused. Amongst over one hundred specimens from five or six different localities I have examined, I find it very difficult to say exactly which is the typical form.

Loc.—Sydney to Cape York, Port Darwin, North West Australia (♂ 40, ♀ 15).

UTICA ONYCHA var. ATROSUFFUSA, var.nov.

♂. 10-11 mm. Neuration and shape as in *U. onycha* (♂) but much smaller; tail shorter and more highly ciliated.

Upperside lilac-blue, much darker basally, with linear brown outer margins; costal margin of hindwing brown; a trace of caudal spot to hindwing; tail black, tipped with white. Cilia white, at terminations of nervules well marked with brown.

Underside.—*Forewing* brown, with markings as in *U. onycha* but darker; apical area whitish-grey, which extends somewhat along outer margin. Outer marginal line black. Cilia white. *Hindwing* with basal half dark brown, outer half whitish-grey, obscuring any markings that may be present; a black outer marginal line, in two specimens no anal or caudal spots, in another slight traces of these spots. Cilia white.

The first specimen of this variety was caught in Sept., 1900, and I at once saw that it was either a marked variety of *U. onycha* or else a new species; but the want of further material deterred me from describing it; since then, however, two other specimens have been caught, tending to show that my original specimen was not an accidental variation. This variety may be distinguished from *U. onycha* by its much smaller size, the deeper shade of blue on upperside, the white outer marginal suffusions, and the very dark basal half of hindwing on underside. Type in the author's collection.

Loc.—Como near Sydney (L. V. Waterhouse and F. Brown).

UTICA ONYCHA var. ALBOCINCTA, var. nov.

This form differs from *U. onycha* in having the upperside suffused with bluish, and the outer margins of both wings marked with whitish bands, which are better defined on hindwing. Two males received from Dr. A. J. Turner, caught at Peak Downs, Q., in July. Though not in the best of preservation, these two specimens show that a most marked variety, if not a distinct species, has hitherto been overlooked.

UTICA SCINTILLATA, Lucas (Plate iii., figs. 15, 36).

Lyc. scintillata, Lucas, Proc. R. Soc. Qsld. 1889, p. 157, f. 8-10.

♂. 12 mm. Upperside bronze-brown, with a shining purplish reflection, outer margins narrowly brown, costal margin of hindwing brown; base of wings dark blue; dark round caudal and anal spots. Tail black, bordered with white. Cilia brown.

Underside.—*Forewing* brown, with darker brown spots and bands as in *U. onycha*, a broad band of white on either side of discal brown band, a brown submarginal lunular band. Cilia brown. *Hindwing* brown, with darker brown spots and band as in *U. onycha*, upper half of discal band disjointed, very dark brown, bordered on either side with broad white bands; caudal spot round, jet black, crowned with orange. Cilia whitish.

♀. 10-13 mm. Upperside.—*Forewing* blackish-brown, with the cell and inner margin from base to near angle covered with pale metallic-blue scales; a variable white spot just beyond end of cell, situated between subcostal and 1st median. Cilia white. *Hindwing* blackish-brown, with a very variable suffusion of pale blue metallic scales between subcostal and submedian, apical angle whitish, outer marginal interneural series of white lunules; caudal spot black, crowned with white. Cilia whitish. Tail black, tipped with white.

Underside as in ♂ but spots and bands much better defined and darker, white patches more extensive.

This beautiful little species appears to be rare, and I have been able to obtain only rather worn specimens for examination; its nearest ally is *Nac. palmyra*, especially on the underside, but the purplish-brown of the male and the pale blue metallic scales of the female easily distinguish it. The female may be distinguished from the females of the allied forms *N. lineata* and *N. palmyra* by the much less extensive white patch of the forewing.

Loc.—Richmond River, N.S.W., to Cairns, Q. (♂ 2, ♀ 8).

OGYRIS, Westwood.

Gen. Diurn. Lep. ii. p. 472, 1850; Misk., Proc. Linn. Soc. N. S. Wales, 1890 pp. 23-28.

Forewing with costa gently arched, apex somewhat acute, outer margin sometimes convex or sometimes straight, inner margin straight. *Hindwing* rounded, often dentate or drawn out at anal angle into a blunt tail, sometimes with three blunt tails. Subcostal nervure of forewing three-branched, the 1st branch being entirely free from costal nervure; anal lobe imperfectly developed.

This remarkable group, with the exception of *O. meekii*, Roths., from New Guinea, is confined to the Australian Continent and Kangaroo Island, and is noted for the brilliancy of the colour of the upperside, and the marked dissimilarity between the sexes.

On account of the marked differences between the sexes, I have found it necessary to give a table of each.

A. ♂. Upperside metallic blue.
  a. Almost linear black outer margins on upperside.
    a^1. Underside with discal band of forewing straight...... *orœtes.*
    b^1. Underside with discal band of forewing irregular...... *hewitsoni.*
  b. Broad black outer margin to forewing.
    a^1. Blue costal margin...... *amaryllis.*
    b^1. Black costal margin...... *ianthis.*
  c. Hindwing produced at anal angle to a blunt tail, a conspicuous apical white splash to forewing...... *œnone.*
B. Upperside purple, with dark margins.
  a. Rich velvet purple, produced at anal angle to a blunt tail, of large size...... *genoveva.*
  b. Rich velvet purple, outer margin of hindwing rounded, of moderate size...... *abrota.*
  c. Dark purple, narrow outer margins, that of hindwing rounded, of moderate size...... *barnardi.*
  d. Dull purple, very broad outer margins, that of hindwing rounded, of moderate size...... *olane.*
  e. Violet-brown, outer margin of hindwing rounded, of large size...... *idmo.*
  f. Purplish-brown, slightly produced at anal angle, of moderate size...... *otanes.*
A. ♀. Upperside metallic blue.
  a. Cell of underside of forewing scarlet.
    a^1. Very broad black margins to forewing...... *amaryllis.*
    b^1. Broad black margins to forewing, black spot at end of cell...... *hewitsoni.*
    c^1. Anal angle produced to a blunt tail...... *œnone.*
  b. Underside with discal band of forewing straight...... *orœtes.*

B. Forewing with a large coloured spot extending into cell.
  a. Spot pale lemon, nearly circular.................................. *abrota.*
  b. Spot rich orange, extending to base.................................. *ianthis.*
C. Forewing with a pale lemon spot external to end of cell of forewing.
  a. Basal colour green, blue, light or dark purple, two or three blunt tails to hindwing .... *genoveva* and vars.
  b. Central areas violet, hindwing rounded, fringes white, of large size .... *idmo.*
  c. Central areas purple, hindwing rounded, of moderate size.. *otanes.*
D. Without any light spot to forewing.
  a. Hindwing on underside with large white blotches on costa *olane.*
  b. Hindwing on underside without white blotches.............. *barnardi.*

OGYRIS GENOVEVA, Hewitson.

Exot. Butt. i. t. 1, figs. 5, 6, ♀, 1853; Misk., Trans. Ent. Soc. Lond. 1883, p. 343, pl. 15; Staud., Exot. Schmett. t. 96, 1888: *O. zosine*, Hew., Exot. Butt., i. t. 1, figs. 3, 4, ♂, 1853; Cat. Lyc. B.M. t. 1, f. 7, ♂, 1862.

The male of this species is dark velvety purple on upperside in southern forms, and dull light purple in northern forms The underside of southern specimens is also much richer and darker. It is difficult to say which is the typical form of the female, my series showing basal coloured areas of green from near Sydney and Brisbane, dark purple from the Richmond River, pale blue from Brisbane, and purplish-blue and dull purple from Townsville. The female has three tail-like projections to the median nervules, the middle one being smallest.

Hewitson described and figured both male and female in the same work and on the same page, so that strictly *O. zosine* should stand for this species, but as it has always been known as *O. genoveva* it is best that that name should be retained. Hewitson figures (Cat. Lyc. B.M.) the underside of *O. zosine* ♀, but this clearly an error for the male, since no pale-coloured subapi blotch is shown. The New Guinea species, *O. meekii*, Roth is close to this species, but has a much better developed tail.

Exp. ♂ 20-28 mm. (25), ♀ 20-31 mm (27) (♂ 25, ♀ 10).

OGYRIS ÆNONE, Waterhouse.

Proc. Linn. Soc. N.S. Wales, 1902, p. 339, pl. xiv. fig. 9 ♂.

Since the description was published last year, Mr. G. Turner has procured three specimens (♂ 1, ♀ 2) from Cooktown, so that I am now able to describe the female.

♀. Shape very much as in ♂.

Upperside.—*Forewing* paler blue, with much broader costal and slightly broader outer margins, a black bar at end of cell, a large white splash on costa very near apex. *Hindwing* paler blue, with broader costal margin, otherwise as in ♂.

Underside.—*Forewing* as in ♂ except that the cell is orange-red between the black spots instead of grey, and that the basal portion between median and submedian nervures is black. *Hindwing* rather darker than in ♂.

Exp. ♂♀ 22 mm. (♂ 1, ♀ 1).

OGYRIS ORŒTES, Hewitson.

Cat. Lyc. B.M. p. 3, t. i. figs. 12, 13 ♀, 1862; Waterh., Proc. Linn. Soc. N.S. Wales, 1902, p. 335, pl. xiv. figs. 1, 2.

This species may be recognised by the acute apex, the straight outer margin and the straight discal band of underside of forewing. Except in shape and shade of blue, this species is identical with *O. hewitsoni* on the upperside.

Loc.—Brisbane to Townsville.

Exp. ♂ 18-20 mm. (19), ♀ 19-22 mm. (21) (♂ 7, ♀ 7).

OGYRIS HEWITSONI, Waterhouse.

Proc. Linn. Soc. N.S. Wales, 1902, p. 338, pl. xiv. figs. 5-8: *O. maryllis*, And. & Spry (nec Hew.), Vict. Butt. p. 103, 1894.

This species closely resembles *O. orœtes* on upperside and *O. ryllis* on underside. Mr. H. Brown has lately caught speci- at Cairns, thus extending its range north from Townsville.

♂ 15-22 mm. (19), ♀ 17-23 mm. (21) (♂ 20, ♀ 7).

OGYRIS AMARYLLIS, Hewitson.

Cat. Lyc. B.M. p. 3, t. 1, figs. 5-6 (♀), 1862; Waterh., Proc. Linn. Soc. N.S. Wales, 1902, p. 336, pl. xiv. figs. 3-4.

This may be recognised by the much darker blue, and the broader margins to the wings on the upperside. The female, as in *O. hewitsoni* ♀, has scarlet in cell of forewing on underside.

Loc.—Northern New South Wales and S. Queensland.

Exp. ♂ 16-20 mm. (18), ♀ 17-22 mm. (19) (♂ 15, ♀ 15).

OGYRIS IANTHIS, Waterhouse.

Proc. Linn. Soc. N.S. Wales, 1900, 52-54, pl. i. figs. 1-4; *l.c.* 1902, 341.

This may be recognised by the metallic blue colour, the very broad margins on upperside of forewing in ♂, the orange central blotch in ♀, and the few and indistinct markings of underside of hindwing. Mr. O. Lower informs me that he has lately received a specimen (♂) from Chillagoe, N.Q., the only other authentic record being Sydney.

Exp. ♂ 15-19 mm. (17), ♀ 15-20 mm. (19) (♂ 20, ♀ 19).

OGYRIS ABROTA, Doubleday & Hewitson.

Gen. Diurn. Lep. t. 75, f. 8 (♀), 1850; Hew., Exot. Butt. i. t. 1, f. 1, 2 (♂), 1853; And. & Spry, Vict. Butt. p. 109, 1894: *O. catharina*, Feld., Reise Nov. Lep. ii. p. 218, 1865.

The male is a rich velvety purple with black margins; and the female may be recognised by the large lemon spot on the forewing. In this species, as opposed to *O. barnardi*, the forewing appears to be rather lengthened, though otherwise they are very close on the upperside. I cannot agree with Mr. Miskin's remark that Hewitson's description does not agree with his figure; in my opinion both figure and description refer to this species. It seems that the name *O. damo* was given to this species in a British Museum List without description.

Loc.—Victoria, New South Wales, S. Queensland.

Exp. ♂ 19-23 mm. (21), ♀ 19-24 mm. (22) (♂ 25, ♀ 15).

OGYRIS BARNARDI, Miskin.

Proc. Linn. Soc. N.S. Wales, 1890, p. 27.

I have seen only four specimens of this species, apparently all males, in the Queensland and Australian Museums. Above they are dark purple, with dark outer margins. The upperside may be described as having the colouration of *O. abrota* with the shape of *O. olane*. On the underside the markings approach *O. olane*, but the hindwing is without the white suffusions of that species. I consider it quite a distinct species. According to Miskin the female is allied to *O. olane* and not to *O. abrota*.

Loc.—Dawson River, Q.

OGYRIS OLANE, Hewitson.

Cat. Lyc. B.M. p. 2, t. 1, figs. 10, 11, 1862; And. & Spry, Vict. Butt. ii. p. 105, 1894.

This species is recognised by the very broad dark margins, leaving the centrobasal areas only purple in ♂, bluish-purple in ♀. On the underside there is usually a whitish suffusion near apex of both wings.

Loc.—South Australia, Victoria, New South Wales, and probably S. Queensland.

Exp. ♂ 18-19 mm. (18), ♀ 17-22 mm. (19) (♂ 5, ♀ 13).

OGYRIS IDMO, Hewitson.

Cat. Lyc. B.M. p. 2, t. 1, figs. 3, 4, 1862; Ill. Diurn. Lep. Lyc. p. 2, 1863; And. & Spry, Vict. Butt. ii. p. 104, 1894: *O. orontas*, Hew., Cat. Lyc. B.M. p. 2, t. 1, figs. 8, 9, 1862.

This species may be recognised by its large size, and not being drawn out towards anal angle; above the male is purplish-brown, the female brown with centrobasal areas purplish, and a yellowish spot just beyond cell of forewing.

In 1862 Hewitson made both his *O. idmo* and *O. orontas* females, but in 1863 he corrected himself, making his *O. orontas* the male and using *O. idmo* for the specific name, as it evidently had been thus given some years before by E. Doubleday in an unpublished British Museum List. *O. idmo* appears as a *nomen nudum* in 'The Genera.' Mr. Miskin does not appear to have noticed this, for in this Society's Proceedings (1890, p. 24) he says that specimens of both sexes of *O. orontas* are in the Australian Museum. I have very carefully examined the specimens in the Australian Museum without finding any but females of *O. idmo*, and a male identical with Hewitson's figure of *O. orontas*. Mr. J. J. Walker has caught this species in West Australia, otherwise it is known from South Australia and Victoria.

Exp. ♂ 26 mm., ♀ 27 mm. (♂ 2, ♀ 1).

OGYRIS OTANES, Felder.

Reise Nov. Lep. ii. p. 217, t. 28, f. 1-3, 1865; Misk., Proc. Linn. Soc. N.S. Wales, 1890, p. 23: *O. halmaturia*, Tepper, Common Insects S. Aust. ii. p. 12, 1890.

In shape the male is like a small male of *O. genoveva*, with scarcely so long an anal projection; colour above brown, with a very faint purplish reflection; the female has the yellowish patch just beyond cell on forewing, and centrobasal areas purplish. On the underside the markings are obscure except those of cell of forewing. My specimens are in very poor condition, but Felder's figures are excellent. Miskin was quite wrong in supposing that this was a southern form of *O. genoveva*. I most certainly agree with Lower who says that Tepper's *O. halmaturia* comprises *O. otanes* ♂ and *O. idmo* ♂.

Loc.—South Australia and Kangaroo Island.

Exp. ♂ 21-22 mm. (21), ♀ 22-23 mm. (22) (♂ 4, ♀ 1).

ARHOPALA, Boisduval.

Voy. Astr. Lep. p. 75, 1832; de Nicév., Butt. Ind. iii. p. 226, 1890: *Amblypodia* auctorum (nec Horsf.).

Forewing with three subcostal nervules, costa gently arched, apex acute, outer margin straight. *Hindwing* furnished with a single tail (in Australian species); anal lobe not very distinct.

The species that this genus was erected for are *A. phryxus*, Boisd., and *A. meander*, Boisd. In Australia the genus is represented by three, somewhat similar, large, brilliantly coloured species, and a smaller, duller-coloured species for which in the future it may be necessary to erect a new genus. The three large species will be included in the following general description; specific details will be found under the various species.

♂. Upperside.—*Forewing* brilliant metallic blue or purple, with narrow brown or black costal and outer margins. *Hindwing* brilliant metallic blue or purple, broad costal, narrow outer brown or black margins. Abdominal fold pale brown.

Underside.—*Forewing* brown, marked by a series of darker brown spots and bands bordered with white. Three spots in cell, one subbasal, second in middle, third marking end of cell, an irregular blotch below second external to cell; a dark spot outwardly bordered with white adjoining cell between 1st and 2nd medians; a straight broad transverse discal band from costa to beyond 1st median. *Hindwing* brown, with darker brown spots and band. A dark spot on costa at base, a series of four subbasal, one above, one in middle of, another below cell, fourth on abdominal margin; a second series beyond these, similarly situated, the last forming on abdominal margin the termination of discal band; end of cell marked by an elongated spot; discal band broad, bent near anal angle, often joined near middle to spot at end of cell. Anal lobe marked with a round black spot, crowned with metallic blue or green scales often extending along margin to 2nd median nervule. Thorax above with metallic scales.

The species may be distinguished:—

A. Of large size; ♂ with narrow, ♀ with broad margins on upperside; brown below.
  a. Underside light brown, often with whitish patches............ *eupolis*.
  b. Underside dark brown.
    a^1. Upperside in both sexes dark purple........................ *amytis*.
    b^1. Upperside in both sexes blue....... .... *meander*.
B. Of moderate size, groundcolour of underside white .... *wildei*.

In his 'Butterflies of India,' &c., de Nicéville assigns over fifty species to this genus from that region.

ARHOPALA MEANDER, Boisduval.

Voy. Astr. Lep. p. 76, 1832; *Amblypodia meander,* Hew., Cat. Lyc. B.M. t. 2, figs. 4-6, 1862.

♂. 22-27 mm. (24). Upperside brilliant shining blue, with a faint greenish suffusion basally, margins narrow, black. Tail black, tipped with white.

Underside.—*Both wings* dark brown, with the spots and bands often hardly discernible, that portion of forewing covered by hindwing pale brown; spots in cell of forewing usually only indicated by their whitish borders; discal area of forewing slightly paler; greenish metallic scales at anal angle.

♀. 22-26 mm. (24). Upperside.—*Forewing* shining blue without a trace of purple; black margin narrow on costa at base, then increasing very much to apex, outer margin very broad. *Hindwing* shining blue, with broad costal and outer margins.

Underside as in ♂, but usually more indefinite; metallic scales at anal angle often wanting.

This species is distinguishable from the two allied forms by the blue colour and the broader black margins of the upperside in both sexes, and by the dark underside, with the markings very often obscured, though I have seen specimens in which the markings are well defined, the spots in the cell often in the ♂ being bordered by metallic scales, and also sometimes in ♂ there is a large whitish patch on costa near apex. Very often the underside has a purplish sheen.

Loc.—Rockhampton to Cape York (♂ 5, ♀ 11).

ARHOPALA AMYTIS, Hewitson.

Amblypodia amytis, Hew., Cat. Lyc. B.M. p. 4, t. 2, figs. 7-9, 1862; Semp., Mus. Godf. Lep. xiv. p. 168, 1878: *A. cyronthe,* Misk., Proc. Linn. Soc. N.S. Wales, 1890, p. 43.

♂. 22-25 mm. (23). Upperside purple, with narrow black margins. Tail black, tipped with white. Cilia brown.

Underside dark brown, with a purplish suffusion, spots and bands darker brown, those in cell of forewing often bordered with metallic blue. Anal angle marked with green scales.

♀. 21-26 mm. (24). Upperside.—*Both wings* purple inclining to blue basally; costal margin black, narrower towards base than at apex where it is widest; outer margin broadly black. Tail black, tipped with white. Cilia white. The black outer margin of hindwing much narrower than that of forewing.

Underside as in ♂ but usually much paler brown, spots in cell of forewing rarely bordered with greenish.

In this species the colour of the sexes on the upperside is more nearly alike than in the other two species; the margins are narrower than in *A. meander;* on the underside it occupies a position intermediate between *A. meander* and *A. eupolis*. With regard to *A. cyronthe*, described by Miskin from two males, which I have seen in the Queensland Museum, I do not think it sufficiently distinct to rank as a separate species.

Loc.—Mackay to Cape York, Port Darwin (♂ 5, ♀ 3).

ARHOPALA EUPOLIS, Miskin (Plate ii., fig. 32).

Amblypodia eupolis, Misk., Proc. Linn. Soc. N.S. Wales, 1890, p. 42.

♂. 20-26 mm. (22). Upperside dull purple, with narrow brown costal and outer margins, base of wings with metallic blue scales. Tail brown, tipped with white. Cilia brown.

Underside.—*Forewing* pale brown, with dark brown markings usually distinctly bordered with white. From apex ⅓ along costa usually a large whitish suffusion. Cilia brown. *Hindwing* pale brown, basal ⅓ with purplish suffusion, bands and spots dark brown bordered with white; often a large whitish suffusion on either side of discal band. Anal metallic scales blue.

♀. 18-26 mm. (23). Upperside purple inclining to blue towards base, with broad dark brown costal and outer margins. Tail dark brown, tipped with white. Cilia brown.

Underside light brown, with darker spots and bands without any patches of whitish as in ♂. Anal metallic scales blue.

The female of this species very closely resembles *A. amytis* ♀ on the upperside, but the underside is very different. The species has a closer resemblance to *A. amytis* than to *A. meander*, and of the three species is the least brilliant.

Loc.—Mackay to Cape York, Port Darwin (♂ 7, ♀ 7).

ARHOPALA WILDEI, Miskin (Plate ii., figs. 6-7).

Syn. Cat. Rhop. Aust. p. 71, 1891.

♂. 20 mm. Upperside dull light blue, with black outer margins. Tail black, tipped with white. Cilia white.

Underside.—*Forewing* white, with a pale brown even costal and outer margin; three darker brown spots in cell, a subapical diagonal row of four spots below which on disc are two others smaller. Cilia at angle white. *Hindwing* white, with brown spots arranged much as in the general description; discal brown band rather broken, beginning on costa with a large oblong blotch. Outer brown margin narrower than in forewing, ill defined. Anal lobe not well developed, marked with black. Cilia white.

♀. 22 mm. Upperside.—*Forewing* with base, costa, apex and outer margin broadly black, inner margin less broadly black; rest of wing white, slightly sprinkled with blue scales on base. Cilia white. *Hindwing* with base, costa and outer margin broadly black; cell black basally, then white slightly suffused with blue scales; central white area not so clearly marked off as in forewing. Tail black. Cilia white.

Underside as in ♂.

This rare and distinct species was for long only known from the types in the Queensland Museum which are not in the best of condition; Miskin's description is good, so that I have only to add to it a few minor details as the result of the two much better specimens I have been able to examine. I know of only five specimens of this rare species, all from Cairns (♂ 1, ♀ 1).

IALMENUS, Hübner.

Verz. bek. Schmett. p. 75, 1816; (part) Hew., Ill. Diurn. Lep. p. 52, 1865.

Forewing with costa gently arched, apex blunt, outer margin nearly straight in ♂, slightly convex in ♀, inner margin straight; subcostal nervure with 3 or 4 branches in ♂, 3 in ♀. *Hindwing* with costa arched, apex round, outer margin straight towards apex, then prolonged into 3 or 4 tail-like projections, which help to discriminate between species, that to 1st median nervule always longest, and usually developed into a long tail. *Anal lobe* well defined. Scheme of marking almost the same for every species, the variation being mainly in colouration.

Upperside.—*Forewing* black or brown, with a metallic patch occupying about ⅓ wing; beginning basally it occupies ½ to whole of cell, extending slightly beyond it, thence sweeping round almost in a circle to inner margin. Nervules in this metallic area well defined. End of cell marked by a conspicuous dark elongate spot. Dark margin paler basally, very wide at apex, decreasing to angle where it ends. *Hindwing* black or brown, with a metallic patch occupying ½ wing, beginning basally and bounded by subcostal and submedian nervures, of greater extent towards anal angle, nervules in this patch well defined. Anal lobe black or orange; a round large jet black caudal spot crowned with red or orange; between 1st median nervule and submedian nervure near margin black or brown, crowned with white or bluish, never orange; a submarginal interneural white line usually more extensive in ♀. The projections always longer in ♀. Abdominal fold paler.

Underside.—*Forewing* some shade of stone-grey or pale brown, with darker spots and bands usually bordered with paler colour; three spots in cell, 1st subbasal, 2nd in middle, 3rd elongate, marking end of cell; below 2nd, outside cell rarely in ♂ but usually in ♀, a very variable spot, sometimes very large, sometimes only a dot; a macular interneural discal band beginning almost from costa, extending to submedian nervure; costal spots smaller, nearly round, others elongate, lowest often inconspicuous, placed usually somewhat nearer base. Outer margin marked with black or brown, just internal to which is a pale orange or brown marginal band, internal to which again is often a darker almost macular submarginal band. *Hindwing* concolorous with forewing. Four subbasal spots, 1st above, 2nd in, 3rd below cell, 4th on margin, 3rd and 4th usually wanting in ♂, rarely in ♀. A band of three spots crossing middle of cell, one above and one below cell, an elongated spot marking end of cell; an interneural macular discal band beginning from costa at about ½, bent near anal angle and then double to middle of inner margin. Caudal and anal lobe spots jet black, conspicuous, crowned with some shade of orange, often with a connecting splash of orange. Outer margin marked with black or brown, just internal to which is a white line; marginal and submarginal bands as in forewing.

The above will include all the species placed in this genus; the varying divergences of colour will be noted under each species. The most marked differences occur in the shape and neuration.

The type of the genus is *I. evagoras*, Don., which has three subcostal branches in both sexes. All the others are similar, except *I. ictinus*, Hew., and *I. lithochroa*, mihi, which have four in ♂; perhaps these two should be placed in *Zesius*, Hübn.,* (type *Z. chrysomallus*, Hübn., from India), but I cannot see any reason for separating two such closely allied species as *I. ictinus* and *I. dämeli*, which were regarded by Miskin as conspecific.

The species may be discriminated by means of the following table :—

A. Tail to 1st median nervule of hindwing nearly ¼ inch.
a. Outer margins black; markings of underside black.
a^1. Metallic areas silvery blue .... *evagoras.*
b^1. Metallic areas opalescent white .... *eubulus.*
c^1. Metallic areas blue (♂ ♀), submarginal bands on underside black .... *eichhorni.*
b. Outer margins brown; metallic areas green ♂, or blue ♀.
a^1. Underside with markings black .... *ictinus.*
b^1. Underside with markings pale brown .... *dämeli.*

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* Verz. bek. Schmett. p. 77, 1816.

B. Tail to 1st median about ⅛ inch; metallic areas green ♂, or blue ♀ .... *lithochroa.*
C. Tail very short, inconspicuous.
  a. Metallic areas green ♂, or blue ♀ .... *inous.*
  b. Metallic areas brassy; of small size.. *clementi.*

IALMENUS EVAGORAS, Donovan (Plates ii., fig. 33; iii., fig. 18).

Pap. evagoras, Don., Ins. New Holl. t. 30, f. 1, 1805; Staud., Exot. Schmett. t. 95, 1888; And. & Spry, Vict. Butt. ii. pp. 97, 98, 1894 : *Poly. cœlestis*, Drap., Ann. Sc. Physc. Brux. ii, p. 354, t. 30, f. 3, 1819.

♂. 17-21 mm. (19); ♀. 16-24 mm. (21). The largest and commonest species of the genus. It is recognised by the very black outer margins, the light silvery blue central areas, and the caudal and anal orange-red blotches. Colour on underside buff, with markings black; (in two specimens light brown). Three subcostal nervules in both sexes.

Loc.—South Australia, Victoria, New South Wales, Brisbane (♂ 14, ♀ 14).

IALMENUS EUBULUS, Miskin.

Trans. Ent. Soc. Lond. 1876, p. 457.

♂. 17-19 mm. (18); ♀. 21 mm. Immediately recognised by the large opalescent white central areas and the narrow black margins. Colour on underside buff, with narrow black markings. It is the lightest in the genus, has the shape and neuration of *I. evagoras*, and takes the place of that species in N. Queensland.

Loc.—Rockhampton, Duaringa, Q. (♂ 2, ♀ 1).

IALMENUS EICHHORNI, Staudinger.

Exot. Schmett. p. 275, 1888; Druce, P.Z.S. 1902, ii. p. 120, pl. xi. f. 11 : *I. itonus*, Misk., Proc. Linn. Soc. N.S. Wales, 1890, p. 41.

♂. 15-17 mm. (16), ♀. 21 mm. At once recognised by the *black* submarginal bands of underside which in all the other species are some shade of brown or orange. Central areas pale bluish-green, the markings from below better reproduced above than in the other species. Shape and neuration as in *I. evagoras*. Why Dr. Staudinger did not figure this species when he described it, instead of his figure of the well known *I. evagoras*, I cannot understand. Druce's figure confirmed my opinion that *I. itonus* was identical with this species.

Loc.—Cape York, Cooktown (Macleay Mus.), Mackay (Lower) (♂ 2, ♀ 1).

IALMENUS ICTINUS, Hewitson (Plate iii., fig. 19).

Ill. Diurn. Lep. p. 54, t. 24, f. 6-8, 1865; And. & Spry, Vict. utt. ii. pp. 98, 99, 1894 : *Austromyrina schraderi*, Feld., Reise ov. Lep. ii. p. 260, t. 32, f. 12, 13, 1865.

♂. 16-19 mm. (17); ♀. 17-21 mm. (19). Outer margins brown, ith central areas green in ♂, blue in ♀. Underside varying m grey to light brown, black markings varying very much in th in different specimens. Shape much as in *I. evagoras*, but ith four and ♀ with three subcostals. Miskin places *I.* *i*, Lucas, as a synonym of this species, but as it has three als in ♂ that is clearly wrong; it is really a synonym of *li.*

-Victoria, New South Wales, Brisbane to Cardwell, 1, ♀ 11).

IALMENUS DÆMELI, Semper.

Godf. Lep. xiv. p. 166, 1878; Druce, P.Z.S. 1902, ii. p. 120, 10, 12 : *I. illidgei*, Lucas, Proc. R. Soc. Qsld. 1889, p. 156,

4-18 mm. (17); ♀. 15-19 mm. (17). Differs from *I. ictinus* in the light brown instead of black markings of underside, with three subcostals instead of four, though in one speci- the terminal portion of the subcostal bifurcates, giving an a nervule but this is given off below rather than above the in subcostal nervure. Miskin considered this species (as *I.* *lidgei*) to be only a variety of *I. ictinus*, but the difference in uration precludes this view. There is no doubt that these two species are very closely allied, too closely to admit of their being placed in different genera as their structural differences would suggest. The specimen of *I. dämeli* with four subcostals shows that it is not always possible to base generic distinction entirely on neuration. I have no doubt that these two species have developed from a common species.

Loc.—Brisbane to Rockhampton (♂ 4, ♀ 6).

IALMENUS LITHOCHROA, n.sp. (Plate ii., fig. 29).

♂. 16-18 mm. (17). Forewing with costa straight, apex acute outer margin straight; subcostal nervure with *four* branches Hindwing with outer margin dentate, projections from 2n median and submedian, and a decided tail from 1st median.

Upperside.—*Forewing* brown, slightly darker on out margin; a metallic greenish area occupying ⅓ wing and extendin from lower half of cell to inner margin; a dark spot at end of ce Cilia white. *Hindwing* brown, with central area met greenish, a prominent round black caudal spot crowned orange; imperfect anal lobe yellowish; an interneural m white line near anal angle. Tail brown, tipped with Abdominal fold brown. Cilia white.

Underside.—*Forewing* light brown, with slightly spots margined with white: two in cell, one marking end another spot below middle of cell; a similar discal band; n area marked by three bands of interneural white spots, th most broad and ill defined, the others often very pr Cilia white. *Hindwing* light brown, with spots similar wing, a subbasal row of three, a transverse row of th spots crossing cell beyond middle, an elongate spot at end below an indistinct spot; discal band broader and more m towards costa, narrowing about middle and bent at anal a marginal area much as in forewing, with inner white band us very conspicuous; on anal lobe a small black spot crowned w yellow; caudal spot large, round, black crowned with orang Cilia white.

♀. 17-19 mm. (18). Shape much as in ♂; subcostal thre branched.

Upperside yellowish-brown, with metallic areas bluish, ger than in ♂; caudal spot larger, orange area on hindwing re extensive. Cilia white.

Underside as in ♂, with spots larger, inner white sub- rginal band well developed.

Loc.—Parkside, South Australia (♂ 8, ♀ 4).

This species may be distinguished from all allied forms by the ry pronounced white borders to the spots on underside, the her white submarginal band, and the tail which is intermediate etween that of *I. inous* and *I. ictinus*. In shape it is more nearly allied to the much smaller *I. inous*, but the male has an extra branch to subcostal. It is important to note that in the very closely related forms placed in this genus, we have two types of neuration in the males, but only one in the females.

I am indebted to Mr. O. B. Lower for this species, which appears under his MS. name of *lithochroa* in several collections.

IALMENUS INOUS, Hewitson (Plate ii., fig. 30).

Ill. Diurn. Lep. p. 54, t. 24, f. 1, 2, 1865; And. & Spry, Vict. Butt. ii. p. 99, 1894: *I. icilius*, Hew., *l.c.* t. 24, f. 3, 1865: *Cupido æneus*, Tepp., Trans. Roy. Soc. S.A. iv. p. 29, t. 2, f. 9, 1882.

♂. 10-16 mm. (14). Upperside brown, with greenish metallic areas; anal lobe yellow; caudal spot black crowned with yellow; very short tail-like projection to 1st median. Cilia brown.

Underside brown, bands and spot brown, sometimes yellow; marginal bands faint, brown or yellow; submarginal bands absent; anal and caudal spots black crowned with yellow. Cilia brown.

. 14-17 mm. (15). Upperside as in ♂, with metallic areas e.

Underside as in ♂, with distinction between groundcolour nd spots better defined.

Loc.—Victoria, South Australia, Swan River (Hew.).

I have a specimen without any markings on the undersi except the two black spots near anal angle. From a care examination of Hewitson's figures, my opinion is that *I. inous* the female and *I. icilius* the male of the same species, though only figures the underside of the latter and states both to males. Druce when writing on the following species makes remark as to Miskin sinking *icilius*, so I conclude that he correct in doing so (♂ 12, ♀ 10).

IALMENUS CLEMENTI, Druce.

P.Z.S. 1902, ii. p. 120, pl. xi. f. 9.

Described as allied to *I. inous* but smaller, metallic area le extensive and more brassy, and anal margin less dentate. Fro the figure the underside appears much more conspicuously marke

Loc.—Touranna Plains, W.A.

Considering the variability of *I. inous*, I should scarcely inclined to separate this as a distinct species.

PSEUDALMENUS, Druce.

P.Z.S. 1902, ii. p. 116.

"Allied to *Ialmenus*, from which it differs by the costal marg being depressed about the middle, not arched as in that genus, the subcostal nervule reaching the margin below apex of fo wing; cell is shorter and broader, in hindwing median nervure longer, with its branches more nearly equal in length, bei caused by the upper nervule being bent upwards more than *Ialmenus*. Palpi more robust, hairy, with terminal joint short Eyes smooth. Type *Thecla myrsilus*, Doubl."

PSEUDALMENUS MYRSILUS, Doubleday (Plate iii., fig. 23).

Thecla myrsilus, D. H. and W., Gen. Diurn. Lep. ii. p. 487, t f. 3, 1852; And. & Spry, Vict. Butt. p. 100, 1894: *T. chlor* Blanch., Voy. Pôle Sud, p. 401, t. 3, f. 15-18, 1853.

♂. 13-16 mm. (15). Upperside.—*Forewing* black, wit central transverse band of orange divided by dark veins, a la black spot marking end of cell. Cilia brown. *Hindwing* bla with an orange blotch just beyond end of cell, a marginal band of red widest at anal angle, narrowing and receding from margin towards apex; in this band three black spots, that on anal lobe often wanting. Tail nearly ¼ in. long, black. Cilia brown.

Underside.—*Forewing* grey, a black spot at end of cell, a black discal band, a yellowish suffusion corresponding to spot of upperside, outer margin brown. Cilia pale brown. *Hindwing* grey, a black spot bordered with white at end of cell, above which is an elongate spot; marginal red band bounded internally by white, externally by black; round black caudal and anal spots, an ovoid black spot above anal angle. Cilia black towards anal angle, pale brown towards apex.

♀. 14-17 mm. (16). Shape as in ♂, with forewing broader.

Upperside as in ♂, orange spot of forewing larger, divided by dark nervules, spot and band of hindwing larger.

Underside as in ♂, with spots and bands larger, someti a broken discal black band to hindwing, usually represented a single spot near anal angle in ♂.

Mr. F. Brown has bred specimens from Katoomba, N.S. with white cilia and groundcolour of underside pure white.

Loc.—Tasmania, Victoria, New South Wales (♂ 10, ♀ 7).

PSEUDONOTIS, Druce.

Ann. Mag. Nat. Hist. ii. p. 252, 1894.

Druce describes his genus as allied to *Thysonotis*, Hübn., (= *Danis*, Fabr.), but differing in having costal nervure free from 1st subcostal, and one subcostal nervule deficient. The species he includes have all, I believe, a single tail, and are shaped and coloured rather as in *Danis* than as in the group represented by *Sithon danis*, Feld. No doubt a new genus will yet be erected to contain this species, which will also include the Australian form

PSEUDONOTIS TURNERI, Waterhouse (Plate ii., fig. 28).

Proc. Linn. Soc. N.S. Wales, 1902, p. 648.

♂. 15-17 mm.; ♀. 12-15 mm. Subcostal only two-branched, 1st branch free from though close to costal nervure.

Loc.—Cairns, Q. (♂ 1, ♀ 2).

HYPOLYCÆNA, Felder.

Wien. Ent. Monat. vi. p. 293, 1862; de Nicév., Butt. Ind. iii. p. 389, 1890.

Both sexes with a two-branched subcostal in forewing; costa of forewing straighter in ♂; anal lobe moderately well developed, two tails each about ¼ inch to 1st median and submedian of hindwing. With the exception of *Pseudonotis turneri*, the two insects placed in this genus are the only recorded Australian species having two long filamentous tails to the hindwing of approximately equal length; in addition the males both have a large circular discoidal black spot on forewing which at once marks them off. Type *H. tmolus*, Feld., from the Philippines.

the two recorded species can be considered distinct, they be separated by the males as follows:—

pperside with central areas shining blue, almost disappearing in some lights.. *phorbas.*
Upperside dark grey somewhat suffused with bluish........... .. *noctula.*

HYPOLYCÆNA PHORBAS, Fabricius (Plate ii., fig. 27).

Hesperia phorbas, Fabr., Syst. Ent. iii. p. 277, 1793, Don., Ins. Ind. t. 41, f. 5, 1800; Hew., Ill. Diurn. Lep. t. 21, f. 5, 7, 8, 1866: *H. dictæa* (♀), Feld., Reise Nôv. Lep. ii. p. 242, t. 30, f. 19, 20, 1865.

♂. 14-19 mm. (16). Upperside.—*Forewing* blue with black outer margin, widest at apex, decreasing to angle; a large round black discocellular spot below which is often a whitish suffusion. Cilia white. *Hindwing* blue inclining to purple, a white marginal line above which is a series of white lunules which together enclose dark spots. Anal angle faintly yellowish. Two equal filamentous tails. Cilia white.

Underside.—*Forewing* greyish-white, a darker bar at end cell and a straight discal band. *Hindwing* greyish-white, a dark subbasal spot between costal and subcostal nervures, a dark bar at end of cell, a dark straight discal band to anal angle where it is bent, running to inner margin; a dark marginal line, above hich is a greyish band. Anal lobe black; caudal spot black, owned with orange. Cilia white.

♀. 15-19 mm. (17). Shape somewhat as in ♂ but broader.

Upperside.—*Forewing* greyish-black, a central whitish spot ich may extend to inner margin or is often nearly effaced. ia white. *Hindwing* greyish-black, a marginal white line ve which is a lunular band, together enclosing dark spots; etimes above this again a band of interneural whitish suffu- ns. Anal lobe yellowish. Tails black lined with white. Cilia ite.

Underside as in ♂.

This is a variable species, particularly the female, which is ten almost without any white on upperside. In the Macleay useum there is a female which has a much more convex ter margin to the forewing, and is a much broader insect, but m inclined to think it is the same species as this.

Loc.—Mackay to Cape York, Thursday Island, Port Darwin ♂ 7, ♀ 6).

HYPOLYCÆNA NOCTULA, Staudinger.

Exot. Schmett. p. 283, t. 96, 1888.

The figure does not appear to be very good, and is much smaller than the average *H. phorbas* ♂. Both figure and description point to a species very close to *H. phorbas* ♂. The upperside is given as a dark grey shot with bluish, and the underside greyish-black with markings evidently much as in *H. phorbas*. It has the two tails and circular patch on forewing as in *H. phorbas* ♂, of which the two known specimens are probably only varieties.

Loc.—Cooktown.

DEUDORIX, Hewitson.

(Part) Ill. Diurn. Lep. p. 16, 1863; de Nicév., Butt. Ind. iii. p. 448, 1890.

Forewing triangular; apex acute, outer margin straight in ♂, slightly convex in ♀; subcostal three-branched. *Hindwing* much produced at anal angle, outer margin nearly straight, a single filamentous tail to 1st median; anal lobe remarkably w developed. Type *D. epijarbas*, Moore.

The two species may be divided—

A. Upperside in ♂ with red central areas, in ♀ grey.................. *diov*
B. Upperside in both sexes with central areas blue...................... *epi*

Deudorix diovis, Hewitson (Plate iii., fig. 24).

Ill. Diurn. Lep. p. 31, t. 7, f. 10-12, 1863.

♂. 14-19 mm. (16). Upperside.—*Forewing* glossy black deep red patch between median and submedian nervures extendi ¾ across wing. *Hindwing* deep red, with dark brown nervules a a broad costal black margin narrowest at apex, abdominal marg pale brown, anal lobe perfect, red centred with black. Tail ¼ i long, black, tipped with white. Cilia black.

Underside.—*Forewing* brownish, with a purple sheen, darker broad spot at end of cell, a broad discal band. Cil brown. *Hindwing* brownish with a purple sheen, a broad spo at end of cell, a very broad discal band, bent near anal angle; anal lobe wholly black, above which are a few metallic scales; caudal spot some distance from margin, black nearly surrounded with yellow. Cilia brown.

♀. 14-18 mm. (17). Upperside.—*Both wings* slate-grey, cilia orange, near anal angle of hindwing white. Cell of forewing black, apex blackish. Anal lobe red, with a black spot covered with metallic scales. Tail long, black, tipped with white.

Underside.—*Both wings* grey, cilia orange, otherwise as in ♂.

This species is the Australian form of the type of the genus, which it very closely resembles in the male, but the female of that species is brown rather than slate-grey. It is a species that fades considerably if exposed to sunlight, many males being light brown on the underside.

Loc.—Richmond River, N.S.W., to Cairns, Q. (♂ 5, ♀ 4).

DEUDORIX EPIRUS, Felder.

Myrina epirus, Feld., Sitzb. Akad. Wiss. Wien, Math. Nat. Cl. xl. p. 452, 1860 : *D. despoena*, Hew., Ill. Diurn. Lep. p. 18, t. 6, f. 1, 3, 1863.

♂. Upperside.—*Forewing* black, a large spot of cærulean blue touching inner margin from base to beyond middle. *Hindwing* with one tail; base of costal margin, apex, and border of abdominal fold pale brown; spot at end of cell, nervules and outer margin black.

Underside—*Forewing* cream, outer margin and submarginal band brown; a large dark brown triangular spot at middle of costa. *Hindwing* cream, crossed at middle by a narrow band, dark brown at first, rufous below, a broad brown band (which nearly meets the last described) near abdominal margin, outer margin near base of tail orange-yellow, bordered above and divided in middle by dark brown dotted with blue; a submarginal pale brown band from middle to near apex.

♀. Upperside—*Forewing* with costal and outer margins broadly black, a minute black spot at end of cell, base and inner margin blue, centre white. *Hindwing* light blue, a large white spot below middle of costal margin, outer margin broadly brown (narrow where the blue meets it) with submarginal line white; anal lobe black.

Underside as in ♂ except that the large spot on forewing is less triangular and the marginal bands broader. Exp. 1·8 in. Hewitson (*l.c.*).

This species is represented in Australia by a single pair in the skin collection from Cape York. They agree with Hewitson's ures, which Kirby sinks under *D. epirus*. The male from Cape rk has no secondary sexual characters, but I have not been e to give it a critical examination to absolutely decide its sence in this genus. The shape is as in *D. diovis*.

RAPALA, Moore.

Lep. Cey. i. p. 105, 1881; de Nicév., Butt. Ind. iii. p. 454, 1890.

Forewing triangular, costa straight, apex acute, outer margin slightly convex, inner margin in ♂ with a broad tuft of hair beneath; subcostal three-branched. *Hindwing* produced towards anal angle, outer margin somewhat straight, a glandular patch of scales between costal and subcostal nervures, a single tail to 1st median, anal lobe well developed. Type *Deudorix varuna*, Horsf.

This genus is closely allied to *Deudorix*, but differs from it in having the hindwing less produced, and by the presence of secondary sexual characters which are absent in *Deudorix*. Of the two Australian species I place in this genus as having secondary sexual characters in the male, *R. democles* after thorough structural examination may have to be removed.

A. Upperside glossy indigo-blue .... *simsoni*.
B. Upperside pale blue .... *democles*.

RAPALA SIMSONI, Miskin (Plate ii., fig. 26).

Deudorix simsoni, Misk., Ent. Mo. Mag. xi. p. 165, 1874: *D. varuna*, Semp., (nec Horsf.) Mus. Godf. Lep. xiv. p. 167, 1878.

♂. 13-17 mm. (15). Shape much as in *D. diovis*.

Upperside deep indigo-blue, much darker on costal margins, outer margins well defined, narrow on hindwing, a white marginal line at anal angle; anal lobe well developed, black, crowned with orange; tail long, filamentous, black, tipped with white. Secondary sexual characters represented by a tuft of black hairs on middle of inner margin of forewing on underside, and a glandular patch of scales on costal margin of hindwing on upperside. Cilia brown.

Underside brown with a purplish reflection, elongate spots marking end of cells, close to which are the broad dark disc bands, near anal angle bordered with white. Anal lobe mark by a large black spot; caudal spot round, black, crowned w white; a suffusion of metallic scales near anal angle. Cilia whi

♀. 15-17 mm. (15). Somewhat broader than in ♂.

Upperside as in ♂ but much paler.

Underside as in ♂ but without the purplish reflection.

Semper records this species under *D. varuna*, Horsf., which, from descriptions, it appears to approach. I am inclined to regard it as the Australian form of *R. orseis*, Hew., as our species exactly agrees with de Nicéville's* remarks on that species.

Loc.—Brisbane to Cape York (♂ 8, ♀ 5).

RAPALA DEMOCLES, Miskin.

Deudorix democles, Misk., Trans. Ent. Soc. Lond. 1884, p. 95.

The only two known specimens, I believe, are two males in the Miskin collection, both with secondary sexual characters, which prevents their being placed in *Deudorix*. Failing a detailed structural examination, I think it best to place the species in *Rapala*. It is shaped much as in the previous species, with the pperside violet-blue margined with black; and the underside ery light brown, with darker transverse bands much as in the evious species. Their size is about 17 mm.

.—Johnston River, Q.

BINDAHARA, Moore.

Cey. i. p. 111, 1881; de Nicév., Butt. Ind. iii. p. 471, 1890.

wing with costa and outer margin nearly straight; sub- ree-branched. *Hindwing* with distinct anal lobe, a *to 1st median, over ½ inch long.*

genus, which contains only one representative in Australia, s from all Australian Lycænidæ in the possession of a very ong tail.

BINDAHARA SUGRIVA, Horsfield (Plate ii., figs. 35-36).

Amblypodia sugriva, Horsf., Cat. Lep. E.I.C. p. 105 (*Thecla sugriva* on pl. i. fig. 10), 1829: *Bindahara sugriva*, de Nicév., Butt. Ind. p. 475, 1890: *B. phocides*, Moore (nec Fabr.), Lep. Cey. i. p. 112, pl. xlii, figs. 3, 3*a*, 1881.

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* Butt. Ind. iii. p. 461, 1890.

♂, 14-17 mm. (16). Upperside.—*Forewing* velvety black. *Hindwing* velvety black, a variable blue patch on apical portion of outer margin.

Underside.—*Forewing* brown, a dark brown spot in cell at base, a broad dark brown band near end of cell, a broad dark brown discal band. *Hindwing* with costal portion brown as on forewing, remainder of wing yellowish, spots and bands not well defined. Anal lobe black; on either side of tail at base a black spot covered with metallic blue scales.

♀. 16-19 mm. (17). Upperside.—*Forewing* greyish-black. *Hindwing* with costa and base greyish-black, rest of wing white. Cilia and borders of tail white.

Underside as in ♂, but the groundcolour white instead of brown; brown marginal bands to forewing and most of markings of hindwing obsolete.

Mr. de Nicéville remarked that the female of this species could not be distinguished from that of *B. phocides*, Fabr. Sempe records this species from Australia as *Sithon isabella*, Feld., Amboina species. Mr. R. E. Turner writes from Ceylon s he does not think *B. sugriva* can be retained for our *subs* though it is very variable. I am, however, inclined to agre Miskin, and regard all the forms of this genus as one ver able species.

Loc.—Townsville to Cape York, [Ceylon (typical)] (♂ ♀

LIPHYRA, Westwood.

Proc. Ent. Soc. Lond. 1864, p. 31; de Nicév., Butt. I p. 489, 1890: *Sterosis*, Feld., Reise Nov. Lep. ii. p. 219, 186

Head rather large; body short, thick; palpi minute; antennæ thick, short, gradually thickened. *Forewing* with subcostal nervure four-branched. *Hindwing* rounded.

LIPHYRA BRASSOLIS, Westwood.

Proc. Ent. Soc. Lond. 1864, p. 31; Dist., Rhop. Malay. p. 204, pl. xxii. fig. 18 ♀, 1884; Staud., Exot. Schmett. p. 269, pl. xciv. ♂, 1888; Misk., Proc. Roy. Soc. Qsld. vi. p. 264, 1889; de Nicév., Butt. Ind. iii. p. 491, figs. 2, 3 1890; Dodd, Entom. 1902, pp. 156, 184 : *Sterosis robusta*, Feld., Reise Nov. Lep. ii. p. 219, pl. xxvii. figs. 10, 11 ♀, 1865.

♂. 35-40 mm. (37); ♀. 36-41 mm. (39). The large size and the orange colour readily distinguish this species. The sexes are somewhat dissimilar in shape and pattern of marking. The Australian form does not appear to differ in any marked degree from specimens from the East Indies.

Loc.—Townsville to Thursday Island, Port Darwin (♂ 2, ♀ 3).

LYCÆNA (?) HYPOLEUCA, Prittwitz.

(nec Koll.), Stett. Ent. Zeit. 1867, p. 273 : *Plebius amazara*, Kirby, Cat. Diurn. Lep. p. 376, 1871.

This species was described from two male specimens, supposed to have come from Botany Bay, having some resemblance to *Candalides erinus*, Fabr., as figured by Donovan.

What the species is I cannot say. The description is not good, nor does there appear to be any definite character given. It is the only species of *Lycænidæ* for which I can find an Australian record, that I am unable to place; and I can only say I doubt very much if the specimens came from Australia. Kirby's name evidently given without seeing a specimen, on his finding Kollar had described a species as *L. hypoleuca* some few before.

ZERITIS THYRA, Linn.

skin, Proc. Linn. Soc. N.S. Wales, 1888, p. 1520.

-Olliff caught two specimens of this species at Newcastle, which, there seems to be no doubt, were imported specimens from South Africa.

In an appendix to his Catalogue, Mr. Miskin gives seven reputed Australian species, but most unfortunately does not mention the Australian references. *Tarucus telicanus*, Lang, is the well known species he gives as *L. pseudocassius*, and is the name that should be used. *L. palemon*, Cram., has been used in error for *Una serpentata*, Herr.-Schff. *Cyaniris puspa*, Horsf., is well known in India and Ceylon, and occurs also in Java, but it is extremely improbable if it was ever caught in Australia. I am unable to find the Australian reference. *Lampides macrophthalma*, Feld., is probably meant for *N. berenice;* it is recorded as Australian by Butler.* *Lampides hermus*, Feld., is identical with *Nac. viola*, Moore. *Lycæna micylus*, Cram., is an African species, and *Danis philostratus*, Felder, is from the Moluccas.

POSTSCRIPT (added July 9th, 1903). While this paper has been passing through the press, Mr. J. A. Kershaw, of Melbourne, sent me for examination a fine insect for which I propose

MILETUS MELEAGRIS, n.sp.

♂. 16 mm. Forewing shaped as in *M. ignita*. Hindwing shaped much as in *M. narcissus*, with a projection to 1st median.

Upperside rich shining purple with very narrow black margins; abdominal fold blackish. Cilia white interneurally.

Underside brown, with markings as indicated in general description (p. 158), red, bordered narrowly with black, then broadly with metallic green. Costa of forewing with a broa metallic green splash; upper ½ of cell orange, two black spots lower ½ of cell, and one below. Outer margins orange, wit interneural series of metallic green spots, wanting at ang forewing, but at anal angle of hindwing developed into a me green band extending nearly half way along abdominal m Cilia whitish, faintly spotted, with two jet black spots at ter tions of submedian and 1st median of hindwing.

Loc.—Cardwell, Q. Type (♂) in Coll. Kershaw (♂ 1).

This species belongs to the *ignita* section of the genus, being shaped much as in *M. epicurus*. It is immediately distinguished by the rich colour and very narrow black apex of upperside, and the remarkable development of metallic green on the underside.

Mr. J. A. Kershaw has allowed me to describe this magnificent species, which brings the number of *Lycænidæ* up to 115 species.

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* Trans. Linn. Soc. Lond. Zool. p. 566, 1877.

EXPLANATION OF PLATES.

Plate ii.

Fig. 1.—*Eupyschellus dionisius*, Boisd.
Fig. 2.—*Neopithecops zalmora*, Butl.
Fig. 3.—*Megisba nigra*, Misk. ♂.
Fig. 4.— „ „ „ ♀.
Fig. 5.—*Zizera delospila*, n. sp.
Fig. 6.—*Arhopala wildei*, Misk. ♂.
Fig. 7.— „ „ „ ♀.
Fig. 8.—*Danis apollonius*, Felder ♀.
Fi- *Una mathewi*, Misk. ♂.
era alsulus, Herr.-Schff. ♂.
aniris tenella, Misk. ♂.
seudodipsas fumidus, Misk. ♂.
„ „ „ ♀.
„ *eone*, Felder ♂.
„ „ „ ♀.
Miletus rovena, Druce ♀.
—*Candalides erinus*, Fabr. ♂.
— „ „ „ ♀.
— „ *acasta*, Cox ♂.
— „ *hyacinthina*, Semper ♂.
1.—*Una sulpitius*, Misk. ♂.
22.—*Lucia pyrodiscus*, Rosen. ♂.
23.— „ „ „ ♀.
24.—*Candalides albosericea*, Misk. ♂.
g. 25.— „ „ „ ♀.
ig. 26.—*Rapala simsoni*, Misk. ♂.
Fig. 27.—*Hypolycæna phorbas*, Fabr. ♂.
Fig. 28.—*Pseudonotis turneri*, Waterhouse ♀.
Fig. 29.—*Ialmenus lithochroa*, n. sp. ♂.
Fig. 30.— „ *inous*, Hew. ♂.
Fig. 31.—*Nacaduba lineata*, Murray ♀.
Fig. 32.—*Arhopala eupolis*, Misk. ♂.
Fig. 33.—*Ialmenus evagoras*, Don. ♂.
Fig. 34.—*Candalides helenita*, Semper ♀.
Fig. 35.—*Bindahara sugriva*, Horsf. ♂.
Fig. 36.— „ „ „ ♀.

—The No. of the top left-hand figure should be 1, not 11. In fig. 29 pot *above* the dotted line is accidental, and should not have appeared.

Plate iii. (Neurations).

Fig. 1.—*Cyaniris* sp. ?
Fig. 2.—*Philiris innotatus*, Misk. ♂.
Fig. 3.—*Candalides hyacinthina*, Semper ♂.
Fig. 4.— ,, *cyprotus*, Olliff ♂.
Fig. 5.— ,, *xanthospilos*, Hübn. ♂.
Fig. 6.— ,, *heathi*, Cox ♂.
Fig. 7.— ,, *acasta*, Cox ♂.
Fig. 8.— ,, *absimilis*, Feld. ♂.
Fig. 9.— ,, ,, ,, ♀.
Fig. 10.—*Catochrysops cnejus*, Fabr. ♂.
Fig. 11.—*Polyommatus bœticus*, Linn. ♂.
Fig. 12.—*Nacaduba dion*, Godt. ♂.
Fig. 13.—*Miletus ignita*, Leach ♂.
Fig. 14.—*Utica onycha*, Hew. ♂.
Fig. 15.— ,, *scintillata*, Lucas ♂.
Fig. 16.—*Nacaduba ancyra*, Feld. ♂.
Fig. 17.— ,, *lineata*, Murray ♀.
Fig. 18.—*Ialmenus evagoras*, Don. ♂.
Fig. 19.— ,, *ictinus*, Hew. ♂.
Fig. 20.—*Danis serapis*, Misk. ♂.
Fig. 21.—*Lucia lucanus*, Fabr. ♂.
Fig. 22.—*Jamides phaseli*, Mathew ♂.
Fig. 23.—*Pseudalmenus myrsilus*, Doubl. ♀.
Fig. 24.—*Deudorix diovis*, Hew. ♂.
Fig. 25.—*Danis taygetus*, Feld. ♂.
Fig. 26.—*Una agricola*, D. W. H. ♂.
Fig. 27.—*Lucia pyrodiscus*, Rosen. ♂.
Fig. 28.—*Megisba malaya*, Horsf. ♂.
Fig. 29.—*Zizera labradus*, Godt. ♂.
Fig. 30.—*Miletus miskini*, n.sp. ♂.
Fig. 31.— ,, ,, ,, ♀.
Fig. 32.— ,, *ignita*, Leach ♂.
Fig. 33.— ,, ,, ,, ♀.
Fig. 34.— ,, *narcissus*, Fabr. ♂.
Fig. 35.— ,, *hecalius*, Misk. ♀.
Fig. 36.—*Utica scintillata*, Lucas ♂.
Fig. 37.—*Nacaduba dion*, Godt. ♂.
Fig. 38.—*Lycænesthes modestus*, n.sp. ♂.
Fig. 39.—*Utica onycha*, Hew. ♂.

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THE VEGETATION OF NEW ENGLAND, NEW SOUTH WALES.

By Fred. Turner, F.L.S., F.R.H.S., etc.

Introduction.

Between the parallels 29° and 31° South and the meridians 151° 20′ and 152° 20′ East lies that portion of New South Wales called New England. Its exact geographical limits have, at one time and another, been the cause of considerable controversy, but as far as this paper is concerned it comprises that portion of the State which extends northwards along the Dividing Range from a little south of Armidale to the Queensland border. It is about 140 miles long by about 60 broad, and has an area of about 5,376,000 acres. The configuration of this area consists of a series of plateaux and a considerable extent of both steeply and gently undulating country. There are also many rugged hills and deep gorges. It rises from an altitude of 3,265 feet at Armidale to 5,000 at Ben Lomond, falling again to 2,831 feet at Tenterfield. The average elevation is about 3,500 feet. Although this portion of New South Wales is only about 80 or 90 miles distant in a straight line from the South Pacific Ocean, still its comparatively high altitude makes it one of the coldest districts in Eastern Australia. The geological formation consists of granitic and metamorphic rocks, which may be said to form the backbone of the Dividing Range. In some places extensive areas of these rocks are covered with trap and basalt, which have resulted from great volcanic disturbances at some period of the earth's history. Excepting on the bare, granitic hills, the soil varies in different localities. About one-third is composed of deep, rich, red soil which has been formed by the disintegration of the basaltic rocks. A large area of the flat country is composed of a stiff, retentive black soil which appears in the form of a deposit, and has most probably been washed down from the surrounding high lands. There is also a large area composed of light, friable loam which is the result of wash from the granitic hills. Over a great part of New England the land is rich and produces excellent cereals and other agricultural crops suitable to temperate climates.

CLIMATE.

Temperature at Armidale.

Mean temperature	56·5° F.
Mean summer temperature... ...	67·7°
Mean winter temperature	44·4°
Highest temperature (shade) ...	105·2°
Lowest temperature (shade) ...	13·9°

Temperature at Tenterfield.

Mean temperature	59·1° F.
Mean summer temperature... ...	69·6°
Mean winter temperature	47·2°
Highest temperature (shade) ...	107·1°
Lowest temperature (shade) ...	12·0°

These temperatures will give a good idea of the climate of New England. In the vicinity of Ben Lomond it will, of course, average a few degrees lower on account of the greater altitude.

RAINFALL.

The mean annual rainfall is 33·1 inches at Armidale, and 34·9 inches at Tenterfield, and may be considered a fairly good one.

WATER.

New England is fairly well watered by several perennial streams, which form tributaries both to the eastern and western rivers. In many localities there are springs of good water, and on some of the low, flat lands water is easily obtained by sinking a few feet into the earth. At Guyra, which lies at an altitude of 4,330 feet, there is a very large lake which, in ordinary seasons, contains a good supply of excellent water which is as clear as crystal. The only thing that detracts from this fine sheet of water, from an æsthetic point of view, is the quantity of so-called rushes (*Heleocharis sphacelata*, R.Br.) which grow over a greater part of it.

VEGETATION.

Since 1890 I have made many botanical excursions to New England and have written special reports on the economic flora growing there, and several of these, together with figures of some of the useful plants, have been published by the Government of New South Wales for the information of pastoralists and others. From time to time I have exhibited before the Members of this Society many botanical specimens I have collected in that part of the State. The vegetation of New England is, in many respects, of an unique character and differs very materially from that growing between its eastern boundary and the sea and from that found outside its western limits. On the east the vegetation is of a purely subtropical nature, and in many places very dense and luxuriant. That growing on the plains to the west consists of trees and shrubs of a more dwarf habit and generally of less luxuriant foliage, except near the watercourses. The vegetation of New England may be described as intermediate between these two. The chief arboreal vegetation is the *Eucalyptus*, of which there are sixteen known species. These are found in varying proportions, and in certain places forests of these valuable trees occur. Several species yield timber of great economic value which is used locally for a variety of purposes. In addition to these there are several fine *Myrtaceous* trees and shrubs, including the beautiful flowering "bottle brush," *Callistemon lanceolatus*, DC., the graceful "tea" tree, *Leptospermum flavescens*, Sm., and the "lily pily," *Eugenia smithii*, Poir., which is always an interesting sight when in fruit. Under *Violarieæ* is the curious shrubby violet, *Hymenanthera dentata*, R. Br., with small, frequently polygamous flowers, and berries of a deep purple colour. *Cheiranthera linearis*, A. Cunn., of the *Pittosporeæ*, is one of the most charming flowering species of that interesting order, and is well worth garden culture for the sake of its large blue flowers. There are three species of *Vitis* and one, *Vitis hypoglauca*, F.v.M., produces bunches of fair-sized fruit locally known as "native grapes," which make good preserves. *Leguminosæ* are represented by numerous species and are well distributed. On some of the slopes the shrubby-growing kinds of *Oxylobium*, *Mirbelia*, *Gompholobium*, *Jacksonia*, *Daviesia*, *Pultenæa*, &c., display a wealth of bloom during the early summer months. Amongst the most beautiful flowering members of this family is *Swainsona galegifolia*, R. Br., but it is a suspected poison plant. Fifteen species are included under the genus *Acacia*, several of which attain large proportions, and certain of them furnish timber for industrial purposes and bark for tanning. Many exotic *Leguminous* plants, both perennial and annual, have become acclimatised and are now apparently wild. The "white clover," *Trifolium repens*, Linn., is very common and when in bloom gives quite an European appearance to many of the pastures. Two very interesting flowering plants, *Callicoma serratifolia*, Andr., and *Bauera rubioides*, Andr., are found in many moist places, and chiefly by the side of watercourses. *Lythrum salicaria*, Linn., grows taller and is more floriferous than I have seen it in any other part of Australia. Darwin gives some very interesting particulars regarding the fertilisation of this widely-distributed plant. Several species of *Passiflora* are found in Australia, but only one, *Passiflora herbertiana*, Lindl., occurs in New England, and although its flowers are not so showy as the tropical American kinds, still the plant is interesting to the botanist. The flannel flower, or Australian "edelweiss," *Actinotus helianthi*, Labill., is fairly abundant in many places, particularly on the hill sides. Three native mistletoes are widely distributed and grow on various species of trees and shrubs. *Loranthus pendulus*, Sieb., is the most common of the three.

Compositæ are a conspicuous feature, and in spring time a large area of both the flat and hilly country is studded with the showy flowers of many species which have a charming effect. *Olearia, Brachycome* and *Helichrysum* are more largely represented by species than any other three genera of this order. Many exotic species, some of an undesirable character, of this family have established themselves almost all over this area. Several species of *Stylidium* and *Goodenia* form a fair percentage of the vegetation in some districts, and are interesting when in bloom. The fertilisation of these plants would repay special study. Growing on some of the granite hills, and particularly in the fissures of the rocks, is a beautiful white-flowering variety of *Isotoma axillaris*, Lindl. Of *Epacrideæ* there are eight genera and fourteen species. The pretty flowering species of *Leucopogon* are fairly plentiful in places, and so are the two species of *Epacris* enumerated in this paper. Climbing plants are not abundant, but occasionally one meets with representatives of the following genera:—*Clematis, Vitis, Passiflora, Rhipogonum, Parsonsia, Marsdenia* and *Tecoma.* Several species of *Solanum* occur here and there and are suspected poison plants. Two allied introduced plants, *Datura stramonium*, Linn., and *D. tatula*, Linn., which usually grow about waste places, are regarded by pastoralists as stock-poisoners. Included under *Scrophularineæ* are several interesting flowering plants, especially those of the genera *Veronica* and *Euphrasia. Labiatæ* are frequently met with, especially species of *Prostanthera*, and one of the native "mints" occasionally makes its presence known by the pleasant perfume its leaves and stems emit when trod upon. *Polygonaceæ* are well represented, and several species are widely diffused. Several genera of *Proteaceæ* are conspicuous in many places, but singular to say, of the forty-three species of *Grevillea* recorded for New South Wales I have found only one in New England. Of the six species of *Pimelea* recorded in this paper some are regarded with suspicion by stockowners. *Wikstrœmia indica*, C. A. Mey., a closely allied plant, is a most ornamental shrub when in fruit. Its red drupes make it a conspicuous object amongst the surrounding vegetation. It has long had, however, an unenviable reputation as a poisonous plant. *Euphorbiaceæ* comprise a larger proportion of the indigenous flora of this region than one would expect to find in such a climate. Most species that I collected, however, were growing in comparatively sheltered situations. The genera *Euphorbia* and *Phyllanthus* are more largely represented by species than any other two genera of this order. That most interesting, closely allied, diœcious plant, *Adriana acerifolia*, Hook., is fairly plentiful in some of the sheltered ravines. A few species of *Ficus*, *Casuarina* and *Frenela* are scattered over this region.

Amongst the *Monocotyledoneæ* the genera *Dendrobium*, *Diuris*, *Prasophyllum*, *Pterostylis* and *Caladenia* of the *Orchideæ* are well represented, particularly the terrestrial species. Although none of the flowers of these species can compare with those indigenous to India and South America, and which are so popular with horticulturists in Australia, Europe and North America, still they are of great interest to the botanist. Under *Liliaceæ* are arranged many genera, and several beautiful flowering species are found both on the mountains and in the valleys. A few species of *Smilax*, *Rhipogonum* and *Geitonoplesium* are stout climbing plants, but by far the greater number are dwarf in habit. In some of the moist places the large flowering "Christmas Bells," *Blandfordia flammea*, Hook., occur in greater or less abundance. And one of the so-called "fringed violets," *Thysanotus tuberosus*, R.Br., is found generally on the higher and drier areas. Several species of *Xerotes* and the allied *Juncus* are scattered over this area, the former usually growing on the higher land and sometimes on the stony hill sides, and the latter generally in wet places and by the side of streams. I have found only one palm, *Kentia monostachya*, F.v.M., in New England, and this occurs in the eastern portion. *Cyperaceæ* are fairly numerous almost all over this region, the genera *Cyperus*, *Fimbristylis*, *Scirpus*, *Cladium* and *Carex* being well represented by species. *Graminaceous* plants which are particularly abundant, are of a rich and varied character, and have a high reputation for fattening stock. *Pani-*

cum, *Andropogon*, *Deyeuxia*, *Danthonia* and *Eragrostis* are more largely represented by species than an equal number of genera of this order. There are thirty-nine genera and seventy-four species of grasses indigenous to New England. Of this number I have figured and described, as to their economic value, forty-nine under the authority of the Government of New South Wales. Several exotic species have become acclimatised and are to be seen growing in varying proportions on most of the grazing areas.

Acotyledoneæ are well represented in New England, more particularly in the eastern portion. In many of the shady ravines and in thickly timbered districts the stately arborescent ferns grow to perfection, whilst the more dwarf species carpet the ground with their beautiful fronds. Some species, as *Aspidium ramosum*, Palis., and *Polypodium scandens*, Forst., creep up the stems of trees and completely envelop the trunks with their graceful fronds, and others, such as *Polypodium serpens*, Forst., and *Polypodium australe*, Mett., may often be seen covering rocks with their curious growth. Four species of filmy ferns of the genera *Trichomanes* and *Hymenophyllum* grow fairly plentifully in the deep and shady gullies, usually near running streams. And in similar situations may be found the curious "club moss," sometimes called "notch fern," *Tmesipteris tannensis*, Bernh. Several epiphytal ferns occur here and there, and there is a robust growing form of *Platycerium alcicorne*, Desv. The genera most largely represented by species are *Pteris*, *Aspidium*, *Asplenium* and *Polypodium*.

This Census of the vegetation of New England includes many plants not hitherto recorded from that portion of New South Wales, and there is little doubt that when many of the deep and sheltered gorges and other places that are difficult of access are botanically explored more species will be recorded, and probably others that are new to science will be found. In the following pages are included all the known *Phanerogamia* and the vascular but not cellular *Cryptogamia*. There is an excellent and an almost unexplored field for the cryptogamic botanist in New England. The *Musci* and *Fungi* are numerous, and the *Lichens* include such genera as *Collema, Cladonia, Usnea, Parmelia, Physcia, Lecidea,* &c.

As this is the first census of the vegetation of New England, I hope it will be found useful to Australian botanists and botanical students, and that it will stimulate others to attempt similar productions in different portions of this Continent where the indigenous vegetation shows a character distinct from that of the surrounding districts. So far back as 1891 I suggested to the Government of New South Wales the advisability of mapping out the State into sections and publishing the indigenous and acclimatised flora of each section for general information. I instanced what the Rev. Dr. W. Woolls, F.L.S., had done with regard to the Parramatta and Sydney floras, and pointed out their value to botanists and botanical students.

All the indigenous plants included in this census that I did not know at sight I have worked out by the diagnosis given in Bentham's 'Flora Australiensis,' and I have followed the same classification and nomenclature as have been adopted in that incomparable work.

The plants marked with an asterisk are exotic, but many of them have become thoroughly acclimatised in New England.

The plants marked with a dagger have been figured and described, as to their economic value, by me.

The localities of the rarer species are given in the accompanying census.

Several persons have, at one time and another, botanised in New England, but those who appear to have made the largest collections of plants prior to 1890 were Mr. C. Stuart and Dr. H. Beckler.

My thanks are due to a number of pastoralists, especially the late Mr. W. H. Walker, of Tenterfield Station, and settlers in New England for forwarding me botanical specimens for identification during the last fifteen years.

An exceptionally busy life has hitherto prevented me from doing full justice to my collections and memoranda, but, as time permits, I purpose publishing accounts of my botanical excursions in Queensland, New South Wales, Victoria, South Australia, West Australia and Tasmania during the last thirty years. I might add that I have often been urged to do this by those who, in this country and Europe, take a great interest in the Australian flora.

The accompanying table shows the percentage of the indigenous Phanerogamia and the Vascular Cryptogamia of New England compared with the similar flora of New South Wales.

NEW SOUTH WALES.		NEW ENGLAND.		PER CENTAGE.	
Dicotyledoneæ.		*Dicotyledoneæ.*			
Genera ...	662	Genera ...	234	Genera ...	35·34
Species ...	2393	Species	418	Species ...	17·46
Monocotyledoneæ.		*Monocotyledoneæ.*			
Genera ...	212	Genera ...	109	Genera ...	51·41
Species ...	668	Species ...	231	Species ...	34·58
Acotyledoneæ.		*Acotyledoneæ.*			
Genera ...	40	Genera ...	26	Genera ...	65·00
Species ...	145	Species .	59	Species ...	40·68
Total Genera	914	Total Genera	369	Genera ..	40·37
Total Species	3206	Total Species	708	Species ...	22·08

Class I. DICOTYLEDONS, Ray.

Subclass I. POLYPETALÆ.

Series I. THALAMIFLORÆ.

RANUNCULACEÆ, B. de Juss.

Clematis microphylla, DC. *Loc.*—Mole River.

Ranunculus lappaceus, Sm.

rivularis, Bks. et Sol.

DILLENIACEÆ, Salis.

Hibbertia stricta, R.Br. var. *hirtiflora.*

acicularis, F.v.M. Nine Mile.

linearis, R.Br.

PAPAVERACEÆ, Juss.

Argemone mexicana, Linn.†*

CRUCIFERÆ, B. de Juss.
- *Nasturtium officinale*, R.Br.*
- *Arabis glabra*, Crantz. Black Mountain.
- *Cardamine dictyosperma*, Hook.
  - *laciniata*, F.v.M.
- *Blennodia trisecta*, Benth.† Sandy Flat.
- *Capsella bursa-pastoris*, Mœnch.†*
- *Lepidium ruderale*, Linn.
  - *sativum*, Linn.*
- *Raphanus raphanistrum*, Linn.*
- *Sinapis arvensis*, Linn.*
  - *nigra*, Boiss.*
- *Sisymbrium officinale*, Scop.*
- *Senebiera didyma*, Pers.*

FUMARIACEÆ, De Cand.
- *Fumaria officinalis*, Linn.*
  - *parviflora*, Lam.*

VIOLARIEÆ, De Cand.
- *Viola betonicæfolia*, Sm.
- *Ionidium filiforme*, F.v.M. Oban.
- *Hymenanthera dentata*, R.Br. Armidale Gully.

PITTOSPOREÆ, R.Br.
- *Bursaria spinosa*, Cav.
- *Billardiera scandens*, Sm. Melrose.
- *Cheiranthera linearis*, A. Cunn. Dumaresq.

POLYGALEÆ, Juss.
- *Polygala japonica*, Houtt.
- *Comesperma retusum*, Labill.

CARYOPHYLLEÆ, Juss.
- *Silene gallica*, Linn.*
- *Cerastium vulgatum*, Linn.*
- *Stellaria pungens*, Brong.
  - *glauca*, With.
  - *media*, Linn.*
- *Spergularia rubra*, Pers.

CARYOPHYLLEÆ.
- *Polycarpon tetraphyllum*, Linn.
- *Lychnis githago*, Lam.*
- *Spergula arvensis*, Linn.*
- *Dianthus prolifer*, Linn.*

PORTULACEÆ, Juss.
- *Portulaca oleracea*, Linn.†

HYPERICINEÆ, St. Hil.
- *Hypericum japonicum*, Thunb

MALVACEÆ, Juss.
- *Malvastrum spicatum*, A. Gray.†
- *Hibiscus sturtii*, Hook. N. of Tenterfield.
- *Malva rotundifolia*, Linn.*
  - *parviflora*, Linn.*
  - *sylvestris*, Linn.*
  - *verticillata*, Linn.*

STERCULIACEÆ, Vent.
- *Sterculia diversifolia*, G. Don.† Beaufort.
- *Rulingia pannosa*, R.Br.
  - *rugosa*, Steetz.

Series II. DISCIFLORÆ.

LINEÆ, De Cand.
- *Linum marginale*, A. Cunn.
  - *gallicum*, Linn.*

GERANIACEÆ, Juss.
- *Geranium dissectum*, Linn.†
- *Erodium cygnorum*, Nees.†
  - *cicutarium*, Willd.*
  - *moschatum*, Willd.* Kentucky.
- *Pelargonium australe*, Willd.
- *Oxalis corniculata*, Linn.

RUTACEÆ, Juss.
- *Boronia polygalifolia*, Sm. Steinbrook.
- *Eriostemon myoporoides*, DC. Bolivia.
- *Phebalium elatius*, Benth.
- *Evodia micrococca*, F.v.M. Bryan's Gap.

SIMARUBEÆ, De Cand.

Cadellia pentastylis, F.v.M.

CELASTRINEÆ, R.Br.

Celastrus australis, Harv. N.E. of Bolivia.
cunninghamii, F.v.M.

STACKHOUSIEÆ, R.Br.

Stackhousia monogyna, Labill.
viminea, Sm.

RHAMNEÆ, Juss.

Pomaderris lanigera, Sm. Wollomombi
elliptica, Labill.
phillyrœoides, Sieb., var. *nitidula.*
Cryptandra amara, Sm.
lanosiflora, F.v.M.
propinqua, A. Cunn.
longistaminea, F.v.M. Near Bear Hill.
Discaria australis, Hook.

AMPELIDEÆ, Kunth.

Vitis antarctica, Benth.
clematidea, F.v.M. Red Range.
hypoglauca. F.v.M.

SAPINDACEÆ, Juss.

Nephelium subdentatum, F.v.M. Kookabookra.
Dodonæa triquetra, Andr.
viscosa, Linn.
attenuata, A. Cunn., var. *linearis.*†

Series III. CALYCIFLORÆ.

LEGUMINOSÆ, Juss.

Suborder I. PAPILIONACEÆ.

Oxylobium trilobatum, Benth. N. of Tenterfield.
Mirbelia pungens, A. Cunn.
speciosa, Sieb.

PAPILIONACEÆ.

Gompholobium huegelii, Benth.
  uncinatum, A. Cunn.
Jacksonia scoparia, R.Br.
Daviesia latifolia, R.Br. Bryan's Gap.
  corymbosa, Sm.
  ulicina, Sm.
  genistifolia, A. Cunn.
Aotus mollis, Benth. Near Bald Nob.
Pultenæa pycnocephala, F.v.M.
  paleacea, Willd.
  microphylla, Sieb. Timbarra.
Dillwynia juniperina, Sieb.
Bossiæa prostrata, R.Br. Lode Hill.
Templetonia muelleri, Benth.
Hovea longifolia, R.Br. Shannon's Vale.
Lotus corniculatus, Linn.
  australis, Andr.
Psoralea tenax, Lindl.
Indigofera australis, Willd.
Swainsona galegifolia, R.Br.†
  brachycarpa, Benth.
  procumbens, F.v.M.†
  oroboides, F.v.M.† Near Mole River.
  lessertiifolia, DC. Jump Up.
Zornia diphylla, Pers. Argenton.
Desmodium brachypodium, A. Gray.
  varians, Endl.
Lespedeza cuneata, G. Don.
Glycine clandestina, Wendl.
  tabacina, Benth.
Vigna vexillata, Benth.
Medicago sativa, Linn.*
  denticulata, Willd.*
  minima, Willd.*
  lupulina, Linn.*
Melilotus parviflora, Desf.*

PAPILIONACEÆ.

Trifolium pratense, Linn.*
repens, Linn.*
agrarium, Linn.*
procumbens, Linn.*
Vicia sativa, Linn.*
villosa, Willd.*
Ervum hirsutum, Linn.*
Ulex europæus, Linn.*

Suborder II. CÆSALPINIEÆ.

Cassia sophera, Linn., var. *schinifolia*.
australis, Sims.
eremophila, A. Cunn.† Sunnyside.

Suborder III. MIMOSEÆ.

Acacia juniperina, Willd.
armata, R.Br.
vomeriformis, A. Cunn. Clive.
stricta, Willd.
neriifolia, A. Cunn.
rubida, A. Cunn.
decora, Reichb. Mole River.
buxifolia, A. Cunn.
venulosa, Benth. E. of Elsmore.
pycnostachya, F.v.M.
longifolia, Willd.
pruinosa, A. Cunn.
spectabilis, A. Cunn. Emmaville.
polybotrya, Benth.
decurrens, Willd.†

ROSACEÆ, Juss.

Rubus parviflorus, Linn.
rosæfolius, Sm.
fruticosus, Linn.*
Acæna ovina, A. Cunn.†
sanguisorbæ, Vahl.

ROSACEÆ.
- *Rosa rubiginosa*, Linn.*
- *Poterium sanguisorba*, Linn.*

SAXIFRAGEÆ, Vent.
- *Callicoma serratifolia*, Andr.
- *Bauera rubioides*, Andr.

CRASSULACEÆ, De Cand.
- *Tillæa verticillaris*, DC.

DROSERACEÆ, Salis.
- *Drosera spathulata*, Labill.

HALORAGEÆ, R.Br.
- *Haloragis serra*, Brongn.
  - *alata*, Jacq.
  - *micrantha*, R.Br. Salisbury Plains.
  - *heterophylla*, Brongn.
  - *tetragyna*, Hook.
- *Myriophyllum verrucosum*, Lindl.

MYRTACEÆ, Juss.
- *Micromyrtus minutiflora*, Benth. Wollomombi.
- *Bæckea densifolia*, Sm. Brockley.
- *Leptospermum flavescens*, Sm.
  - *attenuatum*, Sm.
  - *abnorme*, F.v.M.
- *Callistemon lanceolatus*, DC.
  - *salignus*, DC.
- *Melaleuca genistifolia*, Sm.
- *Angophora intermedia*, DC.
- *Eucalyptus stellulata*, Sieb.
  - *coriacea*, A. Cunn.
  - *amygdalina*, Labill., var.
  - *obliqua*, L'Her.
  - *macrorhyncha*, F.v.M.
  - *leucoxylon*, F.v.M.
  - *melliodora*, A. Cunn.
  - *albens*, Miq.
  - *crebra*, F.v.M.

MYRTACEÆ.

Eucalyptus dealbata, A. Cunn.
  viminalis, Labill.
  rostrata, Schl.
  tereticornis, Sm.
  stuartiana, F.v.M.
  regnans, F.v.M.
  eugenioides, Sieb.
Eugenia smithii, Poir.

LYTHRARIEÆ, Juss.

Lythrum salicaria, Linn.

ONAGRARIEÆ, Juss.

Epilobium junceum, Forst.
  billardierianum, Ser.
Jussiæa suffruticosa, Linn.
Œnothera biennis, Linn.*

PASSIFLOREÆ, Juss.

Passiflora herbertiana, Lindl. Steinbrook.

FICOIDEÆ, Dill.

Tetragonia expansa, Murr.†

UMBELLIFERÆ, Juss.

Hydrocotyle hirta, R.Br.
  laxiflora, DC.
Trachymene australis, Benth.
  incisa, Rudge.
Siebera linearifolia, Benth.
Actinotus helianthi, Labill.
  minor, DC.
Eryngium vesiculosum, Labill. Wellingrove.
Apium australe, Thou.
Daucus brachiatus, Sieb.†
Anethum fœniculum, Willd.*
Conium maculatum, Linn.* Guyra.

ARALIACEÆ, Vent.

Astrotriche floccosa, DC. Steinbrook.

Subclass II. MONOPETALÆ.

LORANTHACEÆ, Juss.

- *Loranthus longiflorus*, Desv.
  - *linophyllus*, Fenzl.
  - *pendulus*, Sieb.

RUBIACEÆ, Juss.

- *Opercularia hispida*, Spreng.
- *Pomax umbellata*, Soland.
- *Asperula scoparia*, Hook.
  - *conferta*, Hook., var. *elongata*.
- *Galium gaudichaudi*, DC.
  - *aparine*, Linn.

COMPOSITÆ, Vaill.

- *Leuzea australis*, Gaud.
- *Centaurea melitensis*, Linn.*
  - *solstitialis*, Linn.†*
  - *calcitrapa*, Linn.†*
- *Vernonia cinerea*, Less. Steinbrook.
- *Olearia rosmarinifolia*, A. Cunn.
  - *stellulata*, Labill., var. *canescens*.
  - *gravis*, F.v.M. Shannon's Vale.
  - *ramulosa*, Benth., var. *communis*.
  - *ramosissima*, Benth.
  - *elliptica*, DC.
- *Vittadinia australis*, A. Rich., var. *dissecta*.
- *Erigeron canadensis*, Linn.*
  - *linifolius*, Willd.*
- *Calotis dentex*, R.Br.
  - *cuneifolia*, R.Br.
  - *lappulacea*, Benth.
- *Lagenophora solenogyne*, F.v.M.
  - *emphysopus*, Hook.
- *Brachycome microcarpa*, F.v.M.
  - *stuartii*, Benth. Bryan's Gap.
  - *scapiformis*, DC.
  - *discolor*, C. Stuart.

COMPOSITÆ.

Brachycome multifida, DC.
Xanthium spinosum, Linn.*
Siegesbeckia orientalis, Linn.
Wedelia biflora, DC.
Spilanthes grandiflora, Turcz. Melrose.
Galinsoga parviflora, Cav.†*
Glossogyne tenuifolia, Cass.
Cotula australis, Hook.
Soliva anthemifolia, R.Br.
Myriogyne minuta, Less. Mole River.
Calocephalus citreus, Less. Mole River.
Craspedia richea, Cass. Ben Lomond.
    chrysantha, Benth.
Ammobium alatum, R.Br.
Cassinia laevis, R.Br.
    quinquefaria, R.Br. Dumaresq.
Ixiolæna brevicompta, F.v.M.
Podolepis acuminata, R.Br.
Leptorhynchus squamatus, Less.
Helichrysum bracteatum, Willd.
    elatum, A. Cunn.
    collinum, DC. Black Mountain.
    apiculatum, DC.
    semipapposum, DC.
    diosmifolium, Less.
    ferrugineum, Less.
    obcordatum, F.v.M.
Helipterum anthemoides, DC.
    incanum, DC.
    dimorpholepis, Benth.
Gnaphalium luteo-album, Linn.
    japonicum, Thunb.
    collinum, Labill.
Erechthites arguta, DC.
Senecio lautus, Forst.

COMPOSITÆ.

Senecio australis, Willd.
  vulgaris, Linn.*
Cymbonotus lawsonianus, Gaud.
Microseris forsteri, Hook.
Hypochœris glabra, Linn.*
  radiata, Linn.*
Picris hieracioides, Linn.*
Sonchus oleraceus, Linn.
Carduus marianus, Linn.*
Cirsium lanceolatum, Scop.*
  arvense, Scop.*
Anthemis cotula, Linn.*
Chrysanthemum segetum, Linn.*
Tragopogon porrifolius, Linn.*
Onopordon acanthium, Linn.*
Cryptostemma calendulaceum, R.Br.†*
Cichorium intybus, Linn.*
Taraxacum officinale, Linn.*

STYLIDIEÆ, R.Br.

Stylidium graminifolium, Swartz.
  debile, F.v.M.
  laricifolium, Rich.
  eglandulosum, F.v.M. Melrose.

GOODENOVIEÆ, R.Br.

Velleia paradoxa, R.Br. Kelly's Plains.
Goodenia bellidifolia, Sm.
  lanata, R.Br.
  hederacea, Sm.
  rotundifolia, R.Br.
  pinnatifida, Schl.
  heteromera, F.v.M. Kelly's Plains.
Scævola spinescens, R.Br.
  microcarpa, Cav.
Dampiera brownii, F.v.M.

CAMPANULACEÆ, Juss.
  Lobelia gibbosa, Labill.
    trigonocaulis, F.v.M.
    purpurascens, R.Br.
  Isotoma axillaris, Lindl., et var. *alba*.
  Wahlenbergia gracilis, DC.

EPACRIDEÆ, R.Br.
  Styphelia viridis, Andr.
  Melichrus rotatus, R.Br.
    urceolatus, R.Br.
  Trochocarpa laurina, R.Br. Near Mount Mitchell.
  Brachyloma daphnoides, Benth.
  Leucopogon lanceolatus, R.Br.
    hookeri, Sond.
    melaleucoides, A. Cunn.
    confertus, Benth.
    neo-anglicus, F.v.M.
  Acrotriche aggregata, R.Br. Red Range.
  Monotoca scoparia, R.Br.
  Epacris longiflora, Cav.
    obtusifolia, Sm.

PLUMBAGINEÆ, R.Br.
  Plumbago zeylanica, Linn. Sunnyside.

PRIMULACEÆ, Vent.
  Lysimachia salicifolia, F.v.M.
    japonica, Thunb. Black Mountain.
  Samolus valerandi, Linn. Rocky River.
  Anagallis arvensis, Linn.*

MYRSINEÆ, R.Br.
  Myrsine crassifolia, R.Br.
    variabilis, R.Br.

JASMINEÆ, Juss.
  Jasminum suavissimum, Lindl. Steinbrook.
  Notelæa microcarpa, R.Br.
    linearis, Benth.

APOCYNEÆ, Juss.
Parsonsia lanceolata, R.Br.
ventricosa, F.v.M. E. of Stannifer.

ASCLEPIADEÆ, R.Br.
Sarcostemma australe, R.Br.† Sunnyside.
Marsdenia flavescens, A. Cunn. Red Range.
Gomphocarpus fruticosus, R.Br.*

LOGANIACEÆ, R.Br.
Mitrasacme indica, Wight.
Logania floribunda, R.Br.

GENTIANEÆ, Juss.
Erythræa australis, R.Br.†
Limnanthemum geminatum, Griseb.

BORAGINEÆ, Juss.
Halgania preissiana, Lehm. Melrose.
Cynoglossum latifolium, Linn. Torrington.
Echium violaceum, Linn.*
Lithospermum arvense, Linn.*

CONVOLVULACEÆ, Juss.
Convolvulus erubescens, Sims.
marginatus, Spreng.
Evolvulus alsinoides, Linn.
Cuscuta australis, R.Br.
epithymum, Willd.*

SOLANEÆ, Juss.
Solanum nigrum, Linn.†
stelligerum, Sm.
amblymerum, Dun.
densevestitum, F.v.M.
semiarmatum, F.v.M.
campanulatum, R.Br. Bonshaw.
Physalis minima, Linn.
Datura leichhardtii, F.v.M. Sunnyside.
stramonium, Linn.†*
tatula, Linn.*

SCROPHULARINEÆ, Mirb.
- *Mimulus gracilis*, R.Br.
- *Gratiola pedunculata*, R.Br.
- *Veronica derwentia*, Andr. Black Swamp.
  - *plebeia*, R.Br.
  - *serpillifolia*, Linn. Ben Lomond.
- *Euphrasia collina*, R.Br. Lode Hill.
  - *scabra*, R.Br.
  - *arguta*, R.Br.
- *Celsia cretica*, Linn.*
- *Verbascum blattaria*, Linn.*
  - *virgatum*, Linn.*
  - *thapsus*, Linn.* Bolivia.
- *Linaria elatine*, Mill.*

LENTIBULARIEÆ, Rich.
- *Utricularia dichotoma*, Labill. Shannon's Vale.

BIGNONIACEÆ, R.Br.
- *Tecoma australis*, R.Br.

ACANTHACEÆ, R.Br.
- *Eranthemum variable*, R.Br.

MYOPORINEÆ, R.Br.
- *Myoporum acuminatum*, R.Br.
  - *deserti*, A. Cunn.† E. of Elsmore.

VERBENACEÆ, Juss.
- *Verbena officinalis*, Linn.
  - *bonariensis*, Linn.*
- *Spartothamnus junceus*, A. Cunn.

LABIATÆ, Juss.
- *Plectranthus parviflorus*, Willd.
- *Mentha satureioides*, R.Br.
- *Lycopus australis*, R.Br.
- *Salvia plebeia*, R.Br.
- *Prunella vulgaris*, Linn.
- *Scutellaria humilis*, R.Br.
- *Prostanthera lasianthos*, Labill.

LABIATÆ.

Prostanthera cœrulea, R.Br. Timbarra.

ovalifolia, R.Br.

phylicifolia, F.v.M.

nivea, A. Cunn. Shannon's Vale.

saxicola, R.Br., var. *major*.

Westringia glabra, R.Br. Kookabookra.

Teucrium corymbosum, R.Br.

argutum, R.Br.

Ajuga australis, R.Br.

Marrubium vulgare, Linn.*

Stachys arvensis, Linn.†*

Molucella lævis, Linn.*

PLANTAGINEÆ, Juss.

Plantago debilis, R.Br.

varia, R.Br.†

lanceolata, Linn.*

major, Linn.*

Subclass III. MONOCHLAMYDEÆ.

PHYTOLACCACEÆ, Endl.

Phytolacca octandra, Linn.*

CHENOPODIACEÆ, Meisn.

Rhagodia hastata, R.Br.† E. of Elsmore.

linifolia, R.Br.

Chenopodium album, Linn.*

triangulare, R.Br.

glaucum, Linn.*

ambrosioides, Linn.*

murale, Linn.*

Atriplex patula, Linn.*

hortensis, Linn.*

AMARANTACEÆ, Juss.

Deeringia celosioides, R.Br. Deepwater.

Amarantus viridis, Linn.

paniculatus, Linn.*

blitum, Linn.*

AMARANTACEÆ.

Trichinium alopecuroideum, Lindl.
macrocephalum, R.Br. Swan Vale.
Nyssanthes erecta, R.Br.
Alternanthera nodiflora, R.Br.
nana, R.Br.

PARONYCHIACEÆ, Meisn.

Scleranthus biflorus, Hook.

POLYGONACEÆ, Juss.

Emex australis, Steinh.†*
Rumex crispus, Linn.*
conglomeratus, Murr.*
acetosella, Linn.*
Polygonum strigosum, R.Br.
prostratum, R.Br.
minus, Huds.
subsessile, R.Br.
lapathifolium, Linn.
aviculare, Linn.*
Muhlenbeckia gracillima, Meisn.
rhyticarya, F.v.M.
cunninghamii, F.v.M. Near the Severn River.

NYCTAGINEÆ, Juss.

Boerhaavia diffusa, Linn.†

MONIMIACEÆ, Juss.

Kibara macrophylla, Benth.
Hedycarya angustifolia, A. Cunn. Steinbrook.

LAURINEÆ, Vent.

Cryptocarya glaucescens, R.Br.
Cassytha pubescens, R.Br.

PROTEACEÆ, Juss.

Petrophila sessilis, Sieb. Beaufort.
Isopogon petiolaris, A. Cunn.
Conospermum taxifolium, Sm.

PROTEACEÆ.

Persoonia cornifolia, A. Cunn.
  sericea, A. Cunn.
  mitchellii, Meisn.
  prostrata, R.Br.
  lanceolata, Andr.
  tenuifolia, R.Br.
Grevillea trinervis, R.Br. N.E. of Guyra.
Hakea eriantha, R.Br. Swan Vale.
  saligna, Knight.
  leucoptera, R.Br.† E. of Stannifer.
  microcarpa, R.Br.
  dactyloides, Cav.
Lomatia ilicifolia, R.Br.
  silaifolia, R.Br.
Banksia collina, R.Br.* Lode Hill.
  integrifolia, Linn.

THYMELEÆ, Juss.

Pimelea glauca, R.Br.
  collina, R.Br. Ben Lomond.
  linifolia, Sm.
  pauciflora, R.Br.
  curviflora, R.Br., var *sericea*.
  altior, F.v.M. Newton Boyd.
Wikstrœmia indica, C. A. Mey. Bryan's Gap.

EUPHORBIACEÆ, Juss.

Euphorbia drummondii, Boiss.
  macgillivrayi, Boiss.
  eremophila, A. Cunn.
  peplus, Linn.*
  helioscopia, Willd.*
Poranthera microphylla, Brong.
Beyeria viscosa, Miq. Mole River.
  lasiocarpa, F.v.M.
Bertya cunninghami, Planch.
rosmarinifolia, Planch.

EUPHORBIACEÆ.

Amperea spartioides, Brong.
Phyllanthus ferdinandi, Muell., var. *minor*.
  gasstrœmii, Muell.
  subcrenulatus, F.v.M.
  thymoides, Sieb. Hillgrove.
  filicaulis, Benth.
Breynia oblongifolia, Muell. N.E. of Tenterfield.
Claoxylon australe, Baill.
Acalypha nemorum, F.v.M. E. of Bolivia.
Adriana acerifolia, Hook.
Carumbium stillingiæfolium, Baill. Steinbrook.

URTICEÆ, Vent.

Trema aspera, Blume.
Ficus rubiginosa, Desf.
  aspera, Forst.
  opposita, Miq.
Pseudomorus brunoniana, Bureau. Near source of the Apsley River.
Elatostemma reticulatum, Wedd.
Parietaria debilis, Forst.
Urtica urens, Linn.*
  dioica, Linn.*

CASUARINEÆ, Mirb.

Casuarina glauca, Sieb.† Swan Vale.
  suberosa, Ott. et Dietr.

PIPERACEÆ, Rich.

Peperomia leptostachya, Hook. et Arn. Drake.
  reflexa, A. Dietr.

SANTALACEÆ, R.Br.

Thesium australe, R.Br.
Santalum lanceolatum, R.Br., var. *angustifolium*. E. of Elsmore.
Choretrum lateriflorum, R.Br.
  candollei, F.v.M. Mole River.

SANTALACEÆ.

Exocarpus cupressiformis, Labill.
 stricta, R.Br.

Subclass IV. GYMNOSPERMÆ.

CONIFERÆ, Juss.

Frenela robusta, A. Cunn.
 rhomboidea, Endl.

CYCADEÆ, Rich.

Macrozamia paulo-gulielmi, F.v.M.

Class II. MONOCOTYLEDONS, Ray.

HYDROCHARIDEÆ, Lam.

Vallisneria spiralis, Linn.

ORCHIDEÆ, R.Br.

Liparis reflexa, Lindl.
Dendrobium æmulum, R.Br.
 kingianum, Bidw. E. of Dundee.
 pugioniforme, A. Cunn.
 linguiforme, Swartz.
 teretifolium, R.Br. Guy Fawkes River.
 mortii, F.v.M. Black Swamp.
Bulbophyllum elisæ, F v.M.
Cleisostoma tridentatum, Lindl. Near Bryan's Gap.
Dipodium punctatum, R.Br.
Galeola cassythoides, Reichb. N.E. of Tenterfield.
Spiranthes australis, Lindl. Ranger's Valley.
Thelymitra ixioides, Sw.
 longifolia, Forst.
Diuris alba, R.Br. Salisbury Plains.
 punctata, Sm.
 aurea, Sm. Graham's Valley.
 maculata, Sm.
 pallens, Benth. Ranger's Valley.
 abbreviata, F.v.M.
 sulphurea, R.Br. Graham's Valley.

ORCHIDEÆ.

Prasophyllum flavum, R.Br.
patens, R.Br.
fuscum, R.Br. Graham's Valley.
Microtis porrifolia, Spreng.
parviflora, R.Br. Salisbury Plains.
Pterostylis reflexa, R.Br.
obtusa, R.Br.
mutica, R.Br.
rufa, R.Br. Ranger's Valley.
Caleana major, R.Br. Mole River.
minor, R.Br. Mole River.
Acianthus exsertus, R.Br.
Eriochilus autumnalis, R.Br.
Caladenia patersoni, R.Br.
suaveolens, Reichb.
carnea, R.Br.
cœrulea, R.Br. Mole River.
Glossodia major, R.Br.
minor, R.Br. Mole River.

BURMANNIACEÆ, Blume.

Burmannia disticha, Linn.

IRIDEÆ, R.Br.

Patersonia glauca, R.Br.
sericea, R.Br.
glabrata, R.Br.
Sisyrinchium micranthum, Cav.*
Libertia paniculata, Spreng. Near Black Swamp.

AMARYLLIDEÆ, St. Hil.

Hæmodorum planifolium, R.Br.
Hypoxis hygrometrica, Labill.
glabella, R.Br.

DIOSCORIDEÆ, Meisn.

Dioscorea transversa, R.Br. N.E. of Bolivia.

LILIACEÆ, De Cand.

Smilax glycyphylla, Sm.

LILIACEÆ.

Smilax australis, R.Br.
Rhipogonum album, R.Br.
    discolor, F.v.M.
    elseyanum, F.v.M.
Dianella lævis, R.Br.
    cœrulea, Sims.
Geitonoplesium cymosum, A. Cunn. N.E. of Bolivia.
Blandfordia flammea, Hook.
Anguillaria dioica, R.Br.
Bulbine bulbosa, Haw. E. of Stannifer.
    semibarbata, Haw.
Thysanotus tuberosus, R.Br.
Cæsia vittata, R.Br.
    parviflora, R.Br.
Tricoryne elatior, R.Br. Clive.
Stypandra glauca, R.Br.
    cæspitosa, R.Br.
Arthropodium paniculatum, R.Br.
    minus, R.Br.
Dichopogon sieberianus, Kunth. E. of Bolivia.
Laxmannia gracilis, F.v.M.
Allium fragrans, Vent.*

PHILYDRACEÆ, R.Br.

Philydrum lanuginosum, Banks.

XYRIDEÆ, Kunth.

Xyris gracilis, R.Br. Graham's Valley.
    operculata, Labill.

COMMELYNACEÆ, Endl.

Aneilema acuminatum, R.Br.
    biflorum, R.Br.
    gramineum, R.Br. Sandy Flat.
Pollia crispata, Benth. N.E. of Hillgrove.

JUNCACEÆ, Agardh.

Xerotes longifolia, R.Br.

JUNCACEÆ.

Xerotes multiflora, R.Br.
filiformis, R.Br.
elongata, Benth.
leucocephala, R.Br.
Luzula campestris, DC. Ben Lomond.
Juncus planifolius, R.Br.
homalocaulis, F.v.M.
communis, E. Mey.
pauciflorus, R.Br.
prismatocarpus, R.Br.
capillaceus, Hook.

PALMÆ, Juss.

Kentia monostachya, F.v.M. N.E. of Tenterfield.

AROIDEÆ, Juss.

Typhonium brownii, Schott.
Gymnostachys anceps, R.Br.

TYPHACEÆ, De Cand.

Typha angustifolia, Linn.
Sparganium angustifolium, R.Br.

LEMNACEÆ, De Cand.

Lemna trisulca, Linn.
minor, Linn. Yarrowyck.

NAIADEÆ, Agardh.

Triglochin procera, R.Br.
Potamogeton natans, Linn.
obtusifolius, Mert. et Koch.

CENTROLEPIDEÆ, Desv.

Centrolepis fascicularis, Labill.

RESTIACEÆ, R.Br.

Lepyrodia scariosa, R.Br.
Restio gracilis, R.Br.
tetraphyllus, Labill.
Hypolæna lateriflora, Benth

CYPERACEÆ, R. Br.

Kyllinga intermedia, R. Br.

Cyperus eragrostis, Vahl. Rocky River.

polystachyus, Rottb.

enervis, R. Br.

difformis, Linn.

tetraphyllus, R. Br.

trinervis, R. Br.

concinnus, R. Br. Nine Mile.

filipes, Benth.

vaginatus, R. Br.

carinatus, R. Br.

rotundus, Linn. †

gunnii, Hook. Ben Lomond.

exaltatus, Retz.

Heleocharis sphacelata, R. Br.

cylindrostachys, Bœck.

acuta, R. Br.

atricha, R. Br. Mole River.

Fimbristylis nutans, Vahl.

monostachya, Hassk.

velata, R. Br.

æstivalis, Vahl.

diphylla, Vahl. Ranger's Valley.

cyperoides, R. Br.

Scirpus fluitans, Linn.

setaceus, Linn.

inundatus, Spreng.

prolifer, Rottb.

lacustris, Linn.

Rhynchospora glauca, Vahl. Wellingrove.

Schœnus melanostachys, R. Br.

vaginatus, F.v.M.

Mesomelæna deusta, Benth.

sphærocephala, Benth.

CYPERACEÆ.

Lepidosperma exaltatum, R.Br.
  laterale, R.Br.
Cladium articulatum, R.Br.
  glomeratum, R.Br.
  tetraquetrum, Hook., and var. *planifolium*.
  gunnii, Hook.
  junceum, R.Br.
Gahnia melanocarpa, R.Br.
  psittacorum, Labill., var. *oxylepis*.
Caustis flexuosa, R.Br. E. of Uralla.
Carex inversa, R.Br.
  paniculata, Linn.
  gracilis, R.Br.
  contracta, F.v.M.
  vulgaris, Fries.
  acuta, Linn.
  lobolepis, F.v.M.
  pseudo-cyperus, Linn. Walcha.

GRAMINEÆ, R.Br.

Paspalum distichum, Linn.†
Eriochloa punctata, Hamilt.†
  annulata, Kunth.†
Panicum sanguinale, Linn.†
  parviflorum, R.Br.†
  leucophæum, H.B. et K.†
  semialatum, R.Br.
  flavidum, Retz.,† var. *tenuior*.
  gracile, R.Br.†
  colonum, Linn. E. of Tenterfield.
  crus-galli, Linn.†
  marginatum, R.Br., et var.
  obseptum, Trin.
  bicolor, R.Br.†
  melananthum, F.v.M.†

GRAMINEÆ.

- *Panicum effusum*, R.Br.†
    - *decompositum*, R.Br.†
    - *prolutum*, F.v.M.†
- *Setaria glauca*, Palis.†
    - *viridis*, Beauv.*
- *Pennisetum compressum*, R.Br.†
- *Cenchrus australis*, R.Br.†
- *Lappago racemosa*, Willd.
- *Hemarthria compressa*, R.Br.†
- *Ischæmum laxum*, R.Br.† Kentucky.
- *Arthraxon ciliare*, Palis.† E. of Glen Innes.
- *Pollinia fulva*, Benth.† W. of Glen Innes.
- *Andropogon sericeus*, R.Br.†
    - *affinis*, R.Br.†
    - *intermedius*, R.Br.†
    - *refractus*, R.Br.†
- *Imperata arundinacea*, Cyr.†
- *Chrysopogon parviflorus*, Benth. W. of Glen Innes.
- *Sorghum plumosum*, Beauv.†
- *Anthistiria ciliata*, Linn.†
- *Arundinella nepalensis*, Trin
- *Polypogon monspeliensis*, Desf.*
- *Microlæna stipoides*, R.Br.†
- *Hierochloa rariflora*, Hook. Ben Lomond.
- *Aristida vagans*, Cav.
    - *ramosa*, R.Br.
- *Stipa setacea*, R.Br.
    - *pubescens*, R.Br.
- *Dichelachne crinita*, Hook.†
    - *sciurea*, Hook.†
- *Agrostis alba*, Linn.
    - *scabra*, Willd.
- *Deyeuxia forsterii*, Kunth.†
    - *billardieri*, Kunth.†
    - *quadriseta*, Benth.†

GRAMINEÆ.

Deyeuxia scabra, Benth.
    breviglumis, Benth. W. of Glen Innes.
Holcus lanatus, Linn.*
Amphibromus neesii, Steud.†
Danthonia carphoides, F.v.M.† Armidale.
    pallida, R.Br.†
    longifolia, R.Br.
    racemosa, R.Br.
    semiannularis, R.Br.†
Echinopogon ovatus, Beauv.†
Pappophorum nigricans, R.Br.†
Cynodon dactylon, Pers.†
Chloris truncata, R.Br.†
Leptochloa chinensis, Nees.
Sporobolus indicus, R.Br.†
Isachne australis, R.Br.†
Phragmites communis, Trin.
Kœleria phleoides, Pers.*
Dactylis glomerata, Linn.*
Eragrostis nigra, Nees.
    pilosa, Palis.†
    leptostachya, Steud.†
    diandra, Steud.
    brownii, Nees.
Poa cæspitosa, Forst., et vars.†
    annua, Linn.*
    glauca, E.B.*
    pratensis, Willd.*
Glyceria fluitans, R.Br.†
    latispicea, F.v.M.
Briza minor, Linn.*
    maxima, Linn.*
Bromus mollis, Linn.*
    sterilis, Linn.*
Ceratochloa unioloides, DC.*

GRAMINEÆ.

Festuca duriuscula, Linn.
  bromoides, Linn.*
Agropyrum scabrum, Palis.†
Lolium perenne, Linn.*
  temulentum, Linn.*
Hordeum murinum, Linn.*
Phalaris canariensis, Linn.*
Avena fatua, Linn.*

Class III. ACOTYLEDONS, Jussieu.

LYCOPODIACEÆ, Swartz.

Lycopodium selago, Linn.
  densum, Labill.
Selaginella uliginosa, Spring.
Azolla rubra, R.Br.
Tmesipteris tannensis, Bernh. N.E. of Glen Innes.
Psilotum triquetrum, Swartz. E. of Stonehenge.

FILICES, Linn.

Schizæa bifida, Swartz.
Gleichenia dicarpa, R.Br.
  flabellata, R.Br.
Todea barbara, T. Moore. Near source of the Mole River.
Trichomanes caudatum, Brackenr.
  apiifolium, Presl.
Hymenophyllum flabellatum, Labill.
  tunbridgense, Sm.
Alsophila australis, R.Br.
  leichhardtiana, F.v.M.
Dicksonia antarctica, Labill.
  youngiæ, C. Moore. E. of Tenterfield.
Davallia pyxidata, Cav.
  dubia, R.Br.
Lindsæa linearis, Swartz.
  microphylla, Swartz. Armidale Gully.
Adiantum æthiopicum, Linn.
  formosum, R.Br. E. of Tenterfield.

FILICES.

Adiantum hispidulum, Swartz.

Cheilanthes tenuifolia, Swartz.

Pteris geraniifolia, Raddi. Black Swamp.

paradoxa, Baker. N.E. of Glen Innes.

falcata, R.Br.

longifolia, Linn.

umbrosa, R.Br.

tremula, R.Br.

aquilina, Linn.

Lomaria patersoni, Spreng.

capensis, Willd.

Blechnum cartilagineum, Swartz.

Doodia aspera, R.Br.

blechnoides, A. Cunn.

caudata, R.Br.

Asplenium flabellifolium, Cav. E. of Bolivia.

falcatum, Lam. N.E. of Bolivia.

flaccidum, Forst.

umbrosum, J. Sm.

Aspidium ramosum, Palis.

unitum, Swartz.

molle, Swartz.

aculeatum, Swartz.

aristatum, Swartz.

decompositum, Spreng.

Polypodium australe, Mett.

tenellum, Forst.

punctatum, Thunb.

serpens, Forst.

confluens, R.Br.

attenuatum, R.Br.

scandens, Forst.

Nothochlæna distans, R.Br. Bolivia.

Grammitis rutæfolia, R.Br. Melrose.

Platycerium alcicorne, Desv.

NOTES AND EXHIBITS.

Mr. Froggatt exhibited specimens of several species of grasshoppers (Fam. *Stenopelmatidæ*) collected in the Bendithere Caves by Mr. Murray, of Moruya. The insects are remarkable for their very long legs and antennæ, and for the absence of ears. They live in the darkest recesses of the caves, and jump about when disturbed. They are allied to the genera *Dolichopoda*, *Macropathus*, &c., the species of which are found in similar situations in Austria, New Zealand or Kentucky, U.S.A.; but, it is believed, this is the first record of such cave-inhabiting Australian Orthoptera.

Mr. Froggatt also showed specimens of two Australian members of the *Acrididæ*, which have a very wide range, namely, (1) *Œdaleus marmoratus*, Thunb. (*Locusta danica*, Linn.), also well known under the name of *Œdipoda musica*, Serv., found likewise in the South of France, India, Ceylon, Africa, Madagascar, some of the islands of the Malay Archipelago, Java, Sumatra, and the Philippines; (2) *Œdaleus senegalensis*, described from Senegal, Africa, by Krauss; and recorded by Saussure from Ternate and Australia. The specimens exhibited were captured on a sandy flat between Leura and Katoomba, Blue Mts., during the last summer; in this locality it seems to take the place of *Œ. marmoratus*.

Mr. H. S. Mort exhibited specimens of two species of Mollusca from Long Bay, namely, *Eulima articulata*, Sowb., a new record for New South Wales; and *Pedicularia stylasteris*, Hedley, a new record for Sydney.

Mr. Baker exhibited fresh specimens of the rare Conifer, *Pherosphæra Fitzgeraldi*, F.v.M., from the base of Wentworth Falls, and also from the first and second falls at Leura, both collected by the Rev. W. W. Watts.

Mr. Maiden sent for exhibition the type specimens of West Australian plants described in Mr. Fitzgerald's paper.

Dr. R. Greig Smith exhibited a series of gummed fruits, and sections of stems and branches in illustration of his paper.

Mr. Carne exhibited photographs and a series of specimens of nepheline-ægyrine rocks to illustrate the occurrence of laccolites in the Barigan district, near Mudgee, N.S.W.; and he described in some detail the origin and characteristics of these interesting dome-shaped rock masses—igneous rocks which had intruded the Coal Measures, and uplifted the overlying Hawkesbury Sandstone but without reaching the surface at the time, though long afterwards subsequently uncovered by denudation; and he gave particulars as to the manner and variable extent to which the seams of coal had been affected by intrusive masses.

Mr. Palmer showed a number of specimens obtained during a visit to Gladstone, Queensland, and illustrating the mineral resources of the locality.

Mr. Waterhouse exhibited (1) representatives of 100 species of Australian *Lycœnidœ* from his own and the Macleay Collections. (2) Specimens of *Euschemon rafflesia*, Macl., and its pupa, an insect considered by some entomologists to be a butterfly, by others a moth. Its Rhopalocerous characters are hooked, clubbed antennæ; palpi and method of flight as in the *Hesperidœ;* larva with a dark hard head; pupa slightly fastened by the tail and enclosed in a sheath formed by drawing two leaves together. Its Heterocerous characters are the presence of a frenulum, and its method of resting with wings outstretched (as is the case in the undoubted Hesperid genera *Phoenicops* and *Netrocoryne).* (3) A pair (♂♀) of *Telesto monticolœ*, Olliff, from Walhalla, Victoria, belonging to Mr. G. Lyell. The only previous record is that of two specimens (♂) from Mt. Kosciusko. The female is as yet undescribed.

Mr. Kesteven exhibited, on behalf of Mr. W. J. Rainbow, and by permission of the Curator, specimens of *Ogyris idino*, Hew., and *O. barnardi*, Misk. (not represented in Mr. Waterhouse's exhibit), from the Australian Museum Collection.

Mr. J. J. Walker offered some remarks upon the interesting character of Mr. Waterhouse's exhibit of *Euschemon rafflesia*. Notwithstanding the presence of the frenulum, he considered the insect to be undoubtedly a butterfly; and from the characters of the pupa to be regarded as referable to the family *Hesperidæ*.

Mr. Steel gave a résumé of the scientific aspects of a recent visit to Great Britain and the United States, and of his gratifying experiences both as the Society's delegate at the last Meeting of the British Association at Belfast, and as a visitor, interested in science, from Australia.

WEDNESDAY, MAY 27TH, 1903.

The Ordinary Monthly Meeting of the Society was held in the Linnean Hall, Ithaca Road, Elizabeth Bay, on Wednesday evening, May 27th, 1903.

Dr. T. Storie Dixson, President, in the Chair.

Mr. ERNEST J. GODDARD, Sydney, was elected a Member of the Society.

The Donations and Exchanges received since the previous Monthly Meeting, amounting to 7 Vols., 36 Parts or Nos., 1 Bulletin, 5 Reports, 4 Pamphlets, and 1 Miscellanea, received from 33 Societies, &c., and 2 Individuals, were laid upon the table.

AUSTRALIAN *PSYLLIDÆ*. PART III.

BY WALTER W. FROGGATT, F.L.S

(Plates iv.-v.).

Since my last contribution to the study of this Family of the Homoptera (these Proceedings, 1901, p. 242) I have collected, and received from my numerous correspondents, some new forms quite as interesting as those previously described; and from the material now in hand (as there still remain in my collection a number of lerp-scales and galls, the makers of which have yet to be discovered) the fauna bids fair to be the richest in the world in respect of these tiny "leaf-fleas." Though the range of many species is limited as far as we yet know, others have a very wide distribution and are readily transported with their food-plants to other countries. *Rhinocola eucalypti*, described by Maskell from New Zealand, where he found it on the young foliage of the Blue Gum, is to be found in every plant nursery or garden about Sydney where seedlings of this Eucalypt are growing. As the tree is also common in Tasmania it is probably a native of that Island. In the last Report of the Government Entomologist at Cape Town it was recorded as plentiful in South Africa on its food plant (*Eucalyptus globulus*). The tiny little aphis-like *Psylla acaciæ-baileyanæ*, which swarms over the ornamental "Cootamundra Wattles" in this State, without apparently doing any damage, was reported last season as having destroyed all the flower buds of many shrubs of the same species growing about the suburbs of Melbourne.

The free psyllids infesting the Acacias and other scrub trees seem to confine themselves to particular species, and are constant in their habits; but those forming lerp-scales upon the Eucalypts have a much wider choice of host, and adapt their structures to the shape of the leaf. Thus *Rhinocola corniculata*, which forms its slender horn-coloured lerp on several different Eucalypts, has been collected recently at Dubbo on *Eucalyptus tereticornis*, var. *dealbata*, and *E. sideroxylon*, at Young on *E. tereticornis*, and at Condobolin on *E. melliodora* and *E. rostrata*.

On further examination I find that *Eriopsylla gracilis* cannot be correctly referred to that genus, but must be placed in *Aphalara*, as the stalk of the subcosta is not as long as the stalk of the cubitus. The figure of the wing given in Pl. xiv., fig. 11, is correct, but the description of the wing in the particular mentioned is wrong.

RHINOCOLA NIGRIPENNIS, n.sp. (Plate iv., fig. 1).

Early stages and life-history unknown; imago caught in sweeping low scrub.

Imago.—Length 0·075 inch, antennæ (?). General colour bright reddish-brown, with dark brown marks in centre of pronotum and on abdominal segments, legs ochreous, wings hyaline, with the whole of central portion clouded with black; nervures light brown. Head with eyes not quite as broad as thorax, deeply angulated behind, flattened, with a deeply impressed fovea on either side of the deep median suture, parallel behind eyes, arcuate on either side, behind basal joint of antennæ forming a blunt tooth beside front of the eyes, rounded and lobed in front. Face lobes broad, rounded, fringed with fine hairs. Antennæ with 1st and 2nd joints very stout, short; rest wanting. Eyes very large, flattened; central ocelli very small, lateral ocelli close to upper angle of eyes. Thorax: pronotum angulated on front margin, sloping to rounded tips, bearing a row of five foveæ and truncate behind; dorsulum small, rounded in front, produced into a blunt tooth on sides, sloping to a truncate apex; mesonotum large, arcuate in front, broadly rounded on sides and hindmargin; scutellum small, angular and truncate in front. Legs stout, long, tibiæ of hind pair dilated at apex and armed with a row of short black spines, with a pair of similar ones in the apex of 1st tarsal joint. Wings long, slender, rounded at tips, more than thrice as long as broad, primary stalk short, stout; stalk of subcosta short, as long as that of cubitus; subcosta running so close to the costal nervure that it almost touches; radius long, curving downwards at tip; upper branch of cubitus long, straight, upper and lower forks short, of nearly equal length; lower branch of cubitus long, upper fork short, rounded, lower fork very short, slightly curved; clavus slender, clavical suture long, slender. Abdomen long. Genitalia : (♀) upper and lower valves short, pointed.

Hab.—Dandenong, Victoria (C. French, Junr.; one specimen).

RHINOCOLA MULTICOLOR, n.sp. (Plates iv., fig. 2; v., fig. 14).

Earlystages and life-historyunknown; imagocaught in sweeping.

Imago.—Length 0·0725, antennæ 0·01375 inch. General colour bright reddish-brown; centre of prothorax, head, legs and antennæ yellow, apical joints of latter fuscous; face lobes red; abdominal segments black, the segmental divisions barred with a fine line of red; wings slightly opaque, clouded in a regular pattern along hind half and tip of forewings with dark brown, inner nervures pink. Head with eyes nearly as broad as thorax, almost truncate in front, with a slight median suture and small fovea on either side, deeply arçuate on hind margin. Face lobes turned down, large, broad, rounded at tips, with an angular cleft between, clothed with long hairs. Antennæ short, 3rd joint longest, 9th-10th short, slightly thickened and rounded at tip. Eyes large, hemispherical, standing out on sides of head; central ocelli in contact with face lobes, lateral ocelli well on hind margin of eyes. Thorax : pronotum angulated in front, sloping down on either side, forming a rounded lobe at the extremities, in line with the eyes; dorsulum broad in centre, running to a point on sides, truncate in centre of hindmargin; mesonotum large, convex, broad, swelling out, and rounded on sides; scutellum broad, somewhat quadrate. Legs stout, hind pair long; tibial spines not conspicuous. Wings long, slender, more than thrice as long as broad, curved at base in front, broadly rounded at tip, and slightly concave on hind margin, primary stalk stout, stalk of subcosta shorter than stalk of cubitus, costal cell elongate, subcostal forming a long slender stigma-like cell running into costal nervure before reaching tip of wing; radius long, curving down just below top of wing; upper cubital branch long, upper fork longer than lower, both turning downward below tip; lower cubital branch short, upper fork long, curving round, lower fork very short and transverse. Abdomen long, slender, sharply arcuate on dorsal surface at the extremity, with an oval valve or process in the curve. Genitalia: (♀) upper and lower valves short, rounded at tips, with a stout spine-like ovipositor produced beyond thorax.

Hab.—Dandenong, Vic. (in sweeping low scrub; C. French, Junr.); Rylestone, N.S.W. (W. W. Froggatt).

Five specimens were sent from Victoria, captured on the 28th of October, when sweeping with a net. I collected four specimens in the same manner about the same time of year. This species in general form of wings and coloration comes near *R. marmorata* from the Blue Mountains, but, among other differences, has very short antennæ, whereas *R. marmorata* has extra long ones.

APHALARA FLAVILABRIS, n.sp. (Plate iv., fig. 3).

Early stages and life-history unknown; imago caught in sweeping low Eucalypt scrub.

Imago.—Length 0·07, antennæ 0·0225 inch. General colour reddish-brown mottled with yellow, face lobes pale yellow; antennæ, legs, upper surface of dorsulum, mesonotum and scutellum pale ochreous-yellow; upper surface of head rich reddish-brown; wings hyaline, with a transverse band of black crossing them, enveloping stalk of subcosta, base of cubital branches, bounded on the inner margin of cubital stalk and both bifurcations of lower branch of cubitus; rest of nervures light ochreous. Head with eyes twice as broad across as long, flattened, with distinct median suture, no fovea, and broad angular cleft in front, sloping down on either side to eyes which are slightly arcuate behind. Face lobes large, broad, rounded and close to tips. Antennæ long, 1st and 2nd joints very short, 3rd very long, rest of nearly uniform length, decreasing in length to apex. Eyes very large, rounded on the outer margins, somewhat reniform in shape; central ocellus very small, at extreme base of median suture; lateral ocelli large, in line with hind angle of eyes. Thorax: pronotum of uniform width, broadest and rugose at extremities, arcuate behind; dorsulum short and broad in proportion, rounded in front, sloping on sides to hindmargin; mesonotum large, arcuate in front, swelling out on either side of dorsulum, angulated at extremities, and rounded behind to junction with small oval scutellum. Legs rather short and stout. Wings nearly thrice as long as broad, coming to almost an acute point at tip; primary stalk moderately long; stalk of subcosta short, but longer than stalk of cubitus, forming a slender well-defined stigma or subcostal cell; radius long, running close to costa and coming out exactly at tip of wing; stalk of cubitus very short, upper branch of cubitus long, upper and lower forks long, forming a large cell, upper one longest; lower branch of cubitus short, upper fork long, curving round, lower fork rounded and curving inward at tip; clavus stout, clavical suture long and distinct. Abdomen broad, coming to a point at tip.

Hab.—Rylstone, N.S.W. (W. W. Froggatt).

APHALARA OBSCURA, n.sp. (Plate iv., fig. 4).

Larva dull yellow, eyes red. Head large, broadly lobed in front on either side, antennæ standing out from eyes, pointed at apex; thorax forming three regular segments, abdomen not as long as thorax, rounded at apex and fringed with short spines round the extremity.

Pupa with dorsal surface ochreous, but so thickly blotched with brown that it shows only as a dorsal stripe down centre of head and thorax, lines behind head and wing-covers forming a square between the latter, and several transverse lines on basal half of abdomen separating these brown bands; ventral surface lighter brown, with abdominal segments marked with transverse bands of blackish spots. Head large, rounded in front, arcuate behind base of antennæ, rounded behind; eyes large; antennæ short, pointed at apex. Thorax short, broad, wing-covers large, broad, rounded at tip; abdomen elongate-oval; legs short, stout.

Imago.—Length 0·0425, antennæ 0·01 inch. General colour ochreous, with darker chestnut markings on head and thorax, antennæ fuscous, lighter on segmental divisions, eyes bright red, ocelli yellow, four broad transverse bands across mesonotum. Wings semiopaque, finely coriaceous, nervures yellow. Head broad, turned down and lobed in front, with a dark median suture and fovea on either side; deeply arcuate behind. Face lobes hidden from above, large, stout, conical, hairy. Antennæ rather short, 1st joint very broad, 2nd short, oval, 3rd longest, 4th-7th short, 8th longer, 9th-10th short, pointed at apex. Eyes very large, reniform; lateral ocelli very small, on lower angle of eye; central ocellus small, hidden from above. Thorax: pronotum curved, ribbon-shaped, impressed with three dark spots; dorsulum spindle-shaped, rounded in front, tapering to extremities; mesonotum large, truncate on both sides, rounded on outer margins; scutellum arcuate in front, with spine on either side of front margin. Legs short, stout, tibiæ long, slender, with apex slightly dilated, and armed with six short black spines. Wings broad, rounded at tips, coriaceous, a little more than twice as long as broad; primary stalk short; stalk of subcosta not as long as stalk of cubitus; subcosta long, indistinct, forming no true stigma; radius long, straight, curving slightly at extremity, coming out just above tip of wing; stalk of cubitus long, upper branch of cubitus very long, upper and lower forks forming a slender cell just below tip of wing; lower branch of cubitus long, upper fork long, bow-shaped, lower fork very short. Abdomen short, pointed to tip. Genitalia: (♀) large, broad, sabre-shaped, upper and lower valves finely pointed.

Hab.—National Park, Sydney, N.S.W. (on *Eucalyptus* sp.; W. W. Froggatt).

APHALARA LEPTOSPERMI, n.sp.

Larva semitransparent, thickly enveloped in a mass of white wool-like filaments; eyes yellow; tip of antennæ, tarsi and rostrum fuscous; centre of abdomen bright yellow. Head lobed in front, large, antennæ standing out in front; abdomen short, broad, rounded at tip.

Pupa pale yellow tinged with green; antennæ, legs, blotches on either side of head, wing-covers, six blotches between them, and five transverse lines and apical portion of abdomen dark brown. Head slightly arcuate in front, sharply curved down on sides to projecting eyes. Thorax short, as broad as head; wing-covers short, oval. Abdomen short, broadly rounded, and somewhat arcuate at tip; apical portion covered with fine close net-like corrugations.

Imago.—Length 0·0575, antennæ 0·1375 inch. General colour pale yellow, centre of abdomen red when viewed from above, tip of antennæ and fine markings on head, thorax and abdomen light brown. Head broad, deeply lobed in front, median suture deep, arcuate on sides and base. Antennæ short, standing out in front, 3rd joint very long, 4th short, apical ones slightly swollen. Face lobes short, broad, rounded at apex, turned down and deeply cleft. Eyes large; central ocellus well down on front of median suture, lateral ocelli near hind margin of eyes. Thorax: pronotum ribbon-shaped, coming to a point at centre, arcuate on sides and base; dorsulum prominent, broad, angulated on sides; mesonotum large, rounded on sides. Wings more than twice as long as broad, not as long as usual, rounded at extremities; primary stalk short, stalk of subcosta shorter than in other species, subcostal nervure indistinct, forming an irregular cell, thickened at tip; stalk of cubitus twice as long as subcostal stalk; radius long, curving down; upper branch of cubitus long, upper and lower forks forming an angulated cell smaller than lower cell formed by furcation of lower branch; clavical suture very stout and distinct. Abdomen wedge-shaped, rather long. Genitalia indistinct in ♂, forming two fine points in ♀.

Hab.—Frankston, Vic. (on *Leptospermum laevigatum*; C. French, Junr.).

The larvæ and pupæ of this species swarm over the tips of the foliage of the tea-tree bushes, covering them with the white wool like filaments under which they hide. Mr. French says :—"My clothes were quite white, and hundreds of the little creatures were crawling over my coat after pushing my way through the scrub."

CARDIASPIS RUBRA, n.sp. (Plate v., figs. 1 and 3).

Early stages and life-history unknown; imago collected on scrub.

Imago.—Length 0·08, antennæ 0·0175 inch. General colour bright red, mottled with dull reddish-orange and ochreous on head and thorax; centre of vertex, legs, antennæ, edges of pronotum, two blotches in centre of dorsulum and five on mesonotum blackish; abdomen red, deeply banded with black, wings slightly opaque, nervures rose-red. Head small, arcuate behind, rounded and slightly lobed in front, with distinct median suture and deep fovea. Face lobes large, spatulate at apex, open at base but in contact at tips. Antennæ short, 4th-9th joints short, apex slightly thickened. Eyes large, truncate on inner margin; central ocelli small, lateral ocelli small. Thorax : pronotum ribbon-shaped, curved in front, an impressed fovea near each extremity, slightly raised on hind margin; dorsulum convex, very short, broad, rounded to a blunt point at extremities; mesonotum large, arcuate in front, somewhat truncate on sides, rounded from hind angle; scutellum large, rounded behind. Legs stout, tibiæ long, terminal joint of tarsi large. Wings elongate-oval, more than twice as long as broad; costal nervure thickened at base to stigma; primary stalk short, stalk of subcosta a little shorter than stalk of cubitus; subcosta running in costa with well-defined stigma; radius emerging above tip of wing; upper branch of cubitus long, straight, upper fork shorter, emerging just below tip of wing, lower fork shorter, turned down; lower branch of cubitus not as long as upper fork; lower fork short, turning down, clavus stout, clavical suture slender. Abdomen very short, broad, terminating in rounded tip. Genitalia in ♀ forming two short valves.

Hab.—Mt. Wellington, Hobart, Tasmania (on *Eucalyptus coccifera;* A. M. Lea; two specimens ♀).

SPONDYLASPIS HIRSUTUS, n.sp. (Plates iv., fig. 6; v., figs. 4 and 5).

Lerp convex, rounded, broadest across centre, light chocolate brown, of a laminated structure, closely attached all round the edges to a leaf, with a flange at base, the whole of the central portion of the lerp clothed with curled filaments, hooked or turned down at tips; 1¾ lines in length.

Pupa.—General colour bright red, thorax dull yellow; blotches behind eyes, spots on dorsal surface of thorax, wing-covers, tarsi, bases and tips of antennæ, and apex of abdomen black. Head small, rounded in front; antennæ moderately long, slender, standing out in front of head; eyes large. Thorax long, not wider than base of head; legs short; abdomen swelling out from tip of wing-covers, rounded to apex.

Imago.—Length 0·085, antennæ 0·025 inch. General colour reddish-brown; head, pronotum, outer margins of dorsulum and scutellum light yellow; abdomen barred with black down the centre of each segment; antennæ and legs ochreous, except the tips of the former, which are fuscous; wings slightly opaque, nervures light brown. Head arcuate in front, sloping down behind base of antennæ, rounded behind eyes; flattened on summit, with a dark median suture, and a very slight fovea on either side. Face lobes very long, slender, rounded on the tips, and separated to near base. Antennæ short, thickened, thickened also at tip; 1st joint very short, broad, 2nd small, the following ones longer. Eyes large, flattened, deeply arcuate on inner margins; central ocellus small, at base of dorsal suture; lateral ocelli small, on upper edge of margin of eyes. Thorax: prothorax ribbon-shaped, curved, with a slight fovea on either side in line with lateral ocelli, broadest and rounded at the extremities; dorsulum short, broad, rounded in front; mesonotum large, slightly arcuate in front, rounded on sides and behind; scutellum arcuate in front, with a slight spur on either edge, but rounded behind, overlapping the mesonotum. Legs moderately long; hind tibiæ swollen at apex and armed with stout spines. Wings rounded on front margins, pointed at apex, more than twice as long as broad primary stalk short, curved; stalk of subcosta long, subcosta forming a long slender cell or stigma running about two-thirds of length of costal nervure; radius long, running close to costa and terminating at tip of wing; cubital stalk short, upper branch of cubitus long; upper and lower forks long, forming a large cell; lower branch long, upper branch long, curving upward and then down; lower fork long, curving outward; clavùs stout, clavical suture long, well defined. Abdomen large. Genitalia indistinct.

Hab.—Thirroul, N.S.W. (on leaves of *Eucalyptus robusta*; W. W. Froggatt).

SPONDYLASPIS NIGRO-CINCTA, n.sp. (Plate v., figs. 2 and 6).

Early stages and life-history unknown; imago taken in sweeping Eucalypt scrub.

Imago.—Length 0·08, antennæ 0·025 inch. General colour rich yellow variegated with black; head yellow with lines round the edges, median suture, fovea, and centre of eyes black; antennæ and inner portion of face lobes fuscous; black blotches on either side of dorsal surface of thorax forming two irregular parallel bands, with two lighter blotches on front margin of pronotum; legs marked with black on thighs, tarsi fuscous; abdomen more black than yellow on dorsal surface; wings semitransparent, nervures horn-colour. Head narrow across, arcuate behind, turned down and flattened in front, with a deep fovea and median suture, deeply cut out in centre, and coming to a sharp angle on either side between antennæ. Face lobes very long, slender, almost cylindrical, rounded at tips, lightly clothed with fine hairs. Antennæ short, 1st joint short, stout, 2nd short, 3rd longest, 4th-8th slender, nearly of equal length, 9th shorter, 10th short, rounded at tip. Eyes very large, standing out on sides of head; central ocelli small; lateral ocelli large, bright wax-red. Thorax: pronotum not reaching to outer margins of eyes, curved in front, narrow, rounded at extremities, a fovea in blackish blotches on either side; dorsulum very small, irregularly oval, coming to a blunt point at sides; mesonotum large, swelling out, arcuate in front, coming to a rounded point on sides; scutellum light yellow, rounded behind Legs long, thighs stout. Wings long, slender, rounded at tips, more than thrice as long as broad. Primary stalk long, costal nervure at base thickened; stalk of subcosta long, subcosta turning up and then forming a long slender stigma; radius long, slender, turning downward to tip of wing; stalk of cubitus short, upper branch of cubitus as long as upper fork, upper and lower forks forming a long narrow cell, turning downward; lower branch of cubitus short, upper fork long, curving round, lower fork long, curving down. Clavus stout, clavical suture very fine. Abdomen long, slender, blunt and round to tip. [Genitalia damaged].

Hab.—Mt. Wellington, Hobart, Tasmania (on *Eucalyptus coccifera;* A. M. Lea; two specimens ♂).

THEA WELLINGTONIÆ, n.sp. (Plate v., figs. 6-7).

Imago.—Length 0·14, antennæ [? broken]. General colour reddish-brown to chestnut with yellowish markings, abdomen and genitalia red marked with black on dorsal surface; wings semi-opaque, pale horn-colour, with a darker smoky shade on apical portion, nervures reddish-brown. Head nearly truncate behind, turned down in front, a distinct median suture, and several small black marks in fovea on either side; arcuate in front, and produced into a broad angular point on sides. Face lobes broad, very short, hidden from above. Antennæ [broken at tip], 1st and 2nd joints short, broad, the rest slender. Eyes large; central ocellus hidden when viewed from above, lateral ocelli small, close to upper margin of eyes. Thorax: pronotum ribbon-shaped, narrowest at extremities, hind margin slightly curled up; dorsulum hexagonal; mesonotum large, arcuate in front, rounded behind, centre black with chestnut on either side; scutellum elongate-oval. Legs short, femora stout, tibiæ short; tibial spines small. Wings nearly thrice as long as broad, not quite so acute at apex as in other species; primary stalk short; stalk of subcosta long; stigma rather long; radius long, curving up slightly at tip; stalk of cubitus long, upper branch curved, upper and lower forks forming a slender cell below tip of wing; lower branch of cubitus short; upper fork long, lower fork curved in at tip; clavus stout, long; clavical suture slender. Abdomen short. Genitalia in ♀ long, slender, sabre-shaped.

Hab.—Summit of Mt. Wellington, Tasmania (on *Eucalyptus coccifera;* A. M. Lea; three specimens, ♀).

PSYLLA ACACIÆ-DEALBATÆ, n.sp.

Larva semitransparent; eyes reddish-brown; centre of abdomen tinged with yellow. Head large, irregularly rounded in front; antennæ stout, standing out in front. Thorax long, quite as broad as head. Legs short, stout. Abdomen swelling out behind thorax, rounded, broad, and flattened at tip.

Pupa pale green, shaded with yellow; antennæ fuscous; eyes reddish-brown; two large fuscous patches on head, and ten spots and four stripes of the same colour on thorax; legs ochreous, shaded with fuscous; wing-covers dark brown, large, projecting; basal portion of abdomen marked with three interrupted slender brown lines and apical portion uniform brown. Thorax large, swelling out behind head, broadly rounded on sides. Abdomen irregularly rounded to tip, fringed with stout hairs.

Imago.—Length 0·0375, antennæ 0·0075 inch. General colour of head, thorax, legs and base of antennæ dull yellow; abdomen bright green; wings semiopaque, horn-coloured, nervures pale yellow. Head not quite as broad as thorax, somewhat flattened, arcuate behind antennæ, slightly lobed in front, a distinct median suture and a small impressed fovea on either side. Face lobes short, broad, angular, deeply cleft in front, somewhat hidden from above. Antennæ moderately long, slender; 1st joint stout, 2nd short, 3rd long, the rest uniform, ending at tip in a distinct club. Eyes large, projecting; central ocellus small, lateral ocelli in line with middle of eyes. Thorax: pronotum ribbon-shaped, curved in front, showing two dark foveæ on either side; dorsulum rounded in front, coming to a point at extremities, truncate at hind margin; mesonotum very large, convex, broad in centre, narrower on either side; scutellum small, arcuate in front. Legs slender. Wings semitransparent, broadly rounded at tips, more than twice as long as broad; primary stalk curving up; stalk of subcosta long, subcosta forming a long slender stigma; radius short; stalk of cubitus short, upper arm curved upward, short; upper and lower forks turned down, forming a long cell a little shorter than the arm; stalk of lower arm of cubitus rather long, upper fork long, curving round, lower fork curving inward; clavus slender; clavical suture very distinct. Abdomen long, slender. Genitalia: (♂) lower genital plate rounded beneath; forceps short, straight and thick; penis small; upper genital plate finger-shaped, bent forwards at tip.

Hab.—Hobart, Tasmania (on foliage of *Acacia dealbata;* A. M. Lea).

PSYLLA GRACILIS, n.sp. (Plate iv., fig. 7).

Imago.—Length 0·065, antennæ 0·0325 inch. General colour light green, slightly tinged with yellow on head and thorax, eyes light brown; antennæ, except tip which is fuscous, pale ochreous; legs of the same colour, with tarsi fuscous; wings transparent, nervures light-coloured. Head broad, swelling out, and rounded in front, deeply arcuate behind, with a slight median suture and shallow fovea on either side. Face lobes closed from base, large, broad, projecting, rounded at apex. Antennæ long, slender; 1st joint stout, swollen; 2nd short, cylindrical; 3rd very long; 4th-8th slender, decreasing to apex; 9th-10th short, slightly clubbed. Eyes reniform; central ocellus very small, almost hidden from above, lateral ocelli rather small. Thorax: pronotum narrow, curved, deeply arcuate behind, rounded on sides, reaching to hind margin of eyes; dorsulum short, broadly rounded in front, truncated, and narrow at extremities, nearly transverse behind; mesonotum large, broad, nearly truncate in front, and produced into rounded lobes on the sides, sloping down and rounded to apex, scutellum small. Legs rather long, tibiæ slender, tarsi small. Wings long, slender, rounded to tips, nearly thrice as long as broad; primary stalk stout, turning upward; stalk of subcosta long, no distinct cross vein, but costa forming a long slender cell; radius long, curving upward and emerging above tip of wing; cubital stalk short, upper branch of cubitus long, curving upward, upper and lower forks forming a long slender cell below tip of wing, lower branch of cubitus long, upper fork long, curving upward and round, lower fork short, turning inward; clavus short. Abdomen rather short and stout. Genitalia: (♀) upper and lower valves forming short blunt processes.

Hab.—Condobolin, N.S.W. (on *Acacia pendula*; specimens obtained by shaking; W. W. Froggatt).

This is one of the free psyllids which run about on the branchlets singly and never cluster together in communities. Though I have never bred them from the larvæ, I have noticed a stout green pupal and larval psyllid thickly coated with white filaments on the tip of the abdomen, which hides among the leaf-stalks; this is probably the immature form of the insect.

PSYLLA ACACIÆ-JUNIPERINÆ, n.sp. (Plates iv., fig. 8; v., fig. 10).

Pupa.—General colour yellow, tips of antennæ and tarsi fuscous, eyes bright red. Head rather small, rounded in front, arcuate behind; antennæ rather long, standing out on side of head. Thorax large, swelling out behind, wing-covers projecting on sides of abdomen. Legs short. Abdomen large, constricted at base, swelling out, oval, rounded to tip, which is clothed with a few stout hairs along hind margin.

Imago.—Length 0·025, antennæ 0·009 inch. General colour black on dorsal surface, with legs and antennæ mottled with dull yellow; eyes bright red; abdomen ochreous, mottled with dark brown, forming short irregular bands across centre; wings pale ochreous, with a large angular white patch in centre of front margin, the rest black or mottled with black. Ventral surface fuscous, central portion of abdomen pale straw-yellow. Head narrow, almost truncate behind, depressed and rugose, an indistinct median suture, broadly lobed in front. Face lobes very small, short, rounded, surmounted with a stout bristle. Antennæ rather short; 1st joint fuscous, short; 2nd ochreous; 3rd longest, tipped with fuscous; 4th-9th of uniform length, clouded at apex;

10th small, surmounted with two short white bristles. Eyes large, hemispherical, standing out on sides of head; central ocellus in line with base of antennæ; lateral ocelli in centre of hind margin of eyes. Thorax: pronotum narrow, not reaching to outer edge of eyes; dorsulum broad, rounded in front, nearly arcuate behind; mesonotum large, projecting, but slightly depressed at summit; scutellum rounded. Legs moderately long, thighs thickened in centre, tibiæ slender, swollen at apex and armed with short black spines round the extremity, an additional short spine on the apex of first tarsal joint. Wings short and broad, twice as long as broad, rounded from tip to hind margin, costal nervure very stout; primary stalk stout, long; stalk of subcosta long, subcosta running close to costa and forming a long slender stigma, radius long, running close to costal and coming out above tip of wing; stalk of cubitus very short; upper branch of cubitus turning upward, upper and lower forks forming a narrow angular cell above tip of wing; lower branch of cubitus long, curving upward, upper fork long, curving round, lower fork rather long, curving outward at tip; clavus short, stout, clavical suture distinct. Abdomen of ♀ long, slender, coming to a point; of ♂ short, wedge-shaped, clothed at tip with fine hairs. Genitalia: (♀) composed of two, short, pointed, black valves.

Hab.—Botanic Gardens, Sydney, N.S.W (on *Acacia juniperina*; J. Jones).

The larvæ and pupæ infest the tips of the foliage of the small prickly wattle, causing the leaflets to become turned down into little rosettes, just as if they had been attacked by aphids.

TRIOZA TASMANIENSIS, n.sp. (Plate v., fig. 13).

Larva black, eyes ochreous, central dorsal line and segmental marks between head, thorax and abdomen well defined, pale yellow; very concave, thickly covered with a white floury secretion, outer margin fringed with white woolly flocculent filaments. General form oval, but when crawling about the abdomen is turned up behind. Tips of antennæ and legs dark brown; undersurface of head and thorax dull white; abdomen light green with a yellowish tint, wrinkled and convex. Legs short, stout.

Imago.—Length 0·085, antennæ 0·025 inch. General colour of head, antennæ, upper surface of thorax and abdomen black; legs dark brown, with lighter markings on the joints. Ventral surface of head, thorax, and tip of abdomen ochreous, the rest pale yellowish-green. Wings dull opaline, nervures dark brown, tinged with yellow at base. Head small, lobed and deeply cleft in front, rounded to eyes, arcuate behind. Face lobes very short, broad, rounded, clothed with fine hairs. Antennæ long, slender, filiform; 1st joint short, broad; 2nd short, cup-shaped; 3rd-8th irregular, slender; 9th swollen at tip; 10th very short and swollen. Eyes very large, rounded on sides, angular on inner margins; lateral ocelli in line with hind margin of eyes; central ocellus at at apex of median suture. Thorax: prothorax very narrow behind, curving round, forming a lobe on either side behind eyes; dorsulum large, rounded in front, sloping on sides to a point on outer margins, with a small rounded lobe behind in line with base of wings; mesothorax broad, arcuate in front, sloping on sides and rounded behind; scutellum large, rounded. Legs: femora short, stout, rounded; tibiæ of fore and middle legs short, hairy; those of hind pair longer, with the apical edge fringed with fine black spines; tarsi very short and broad, claws large. Wings nearly thrice as long as broad, finely coriaceous, broadly rounded at apex, nervures thick, primary stalk long, costal cell nearly transverse at apex; stalk of subcosta very short, radius long, upper branch of cubitus long, curving downward, upper and lower forks nearly of equal length, forming an angular cell, upper fork emerging at tip of wing, lower branch of cubitus not quite as long as lower fork; upper fork long, curving round, clavus short and stout. Abdomen short, tapering to apex. Genitalia: (♂) long, tubular, lower genital plate short, broad, rounded; forceps short, cylindrical, curved inwards; upper genital plate long, cylindrical, standing straight out above point of abdomen.

Hab.—Hobart, Tasmania (galls on *Eucalyptus amygdalina;* A. M. Lea).

This appears to be one of the commonest gall-producing species in Tasmania. I have had a number of specimens all on the same species of slender-leaved "Mallee Gum." The galls are produced by the larvæ attacking the upper surface of the leaves, which become thickened, little circular rosettes forming round each larva; these swelling out, side by side, often coalesce and cause the infested leaf to curl right round into an aborted mass, carrying from two to thirteen which when crowded together are much smaller than isolated specimens which measure up to 2 lines in diameter at the base and 2 lines in height. The basal attachment to the leaf is circular, flattened on the under surface of the leaf, the apical portion bearing a circular boss in the centre surrounded with a number of irregular, truncate, fleshy tubercles or fine finger-like projections, forming a rosette-like structure. The enclosed chamber is of an irregular rounded form, smooth, shining, with a conical point at the apex below the button. The galls split on the upper surface when the enclosed pupa is ready to make its final pupation and come forth as a perfect insect.

TRIOZA DOBSONI, n.sp. (Plates iv., fig. 11; v., fig. 15).

Pupa black on dorsal surface, with lines on head, thorax and segmental divisions of abdomen reddish-brown; antennæ and legs fuscous, eyes dark brown, ventral surface light reddish-brown. The short, broad, cephalic portion enfolded on the sides by the thoracic shield, with a dorsal stripe down the centre of both; wing-covers only swelling out towards base of abdomen, the latter rounded to apex. The whole forms a broad, convex shield, fringed with short semitransparent spines, and lightly clothed with white floury dust.

Imago.—Length 0·075 inch, antennæ [?]. General colour dark chestnut-brown, with stripes and bars of light brown on dorsal surface, wings semitransparent, nervures brown. Head longer than usual in proportion to width, flattened on either side of median suture, deeply arcuate behind, arcuate in front. Face lobes large, broad, rounded at tips. [Antennæ wanting]. Eyes large, projecting, rounded on outer edges; central ocellus at apex of median suture, lateral ocelli well up on hind margin of eyes. Thorax: pronotum almost angular in front, tapering off on sides; dorsulum broad in centre, rounded on sides, tapering to extremities; mesonotum large, arcuate in front, rounded behind; scutellum large. Legs stout, femora thickened, tibiæ long, tarsal joints and claws large. Wings long, slender, rounded at tips, nearly four times as long as broad; primary stalk very long; stalk of subcosta short; radius short, upper branch of cubitus curving downward, the upper and lower forks of equal length, forming a small angular cell, upper one emerging just above tip of wing, lower branch of cubitus rather long, upper fork long, curving round, lower fork short, curving in at apex; clavus stout, clavical suture slight; granulated striæ indistinct. Abdomen slender, rounded at apex. Genitalia: (♂) short and broad; lower genital plate broad, rounded, and fringed with fine hairs; forceps short, broad; upper genital plate long, slender, finger-shaped.

Hab.—Mount Wellington, Hobart, Tasmania (on foliage of *Eucalyptus amygdalina*; A. M. Lea).

The larvæ attack the slender leaves, causing them to curl round, thicken, and become brown; each larva buried in the tissue forms an irregularly rounded blister, in the centre of which it remains in a cell, sucking up the sap until ready to emerge through the upper surface of the aborted leaf, which cracks and opens. Generally an infested leaf contains so many larvæ that the galls touch one another in regular rows.

TRIOZA OLEARIÆ, n.sp. (Plates iv., fig. 11; v., figs. 11 and 15).

Larva semitransparent, a faint touch of yellow in abdomen, eyes red. Head and thorax perfectly rounded, antennæ standing out like two little points; abdomen broader and flattened.

Pupa pale yellow, sometimes with a greenish tint. Head small, narrow, rounded in front, truncate behind; antennæ very short, stout at base, curving round like a ram's horn; eyes large, dark brown, not projecting. Thorax large, swelling out in front, rounded on sides, slightly keeled down the centre; wing-covers large, not projecting; legs short and stout, the whole finely fringed with cilia. Abdomen large, swelling out behind.

Imago.—Length 0·06, antennæ 0·01375 inch. General colour pale green, tips of antennæ and tarsi fuscous, eyes silvery; wings hyaline, finely crenulated; nervures semitransparent. Head small, eyes nearly as broad as thorax, arcute behind, truncate in front, with a slight median suture. Face lobes short, broad at base, angular, clothed with fine hairs. Antennæ moderately long, standing out on front of head, very slender; 1st-2nd short, broad, 3rd very long, 4th-8th shorter, 9th-10th short, slightly thickened. Eyes very large, projecting; lateral ocelli large, situate about the centre of hind margin of eyes, central ocellus very small. Thorax: pronotum very narrow, sharply rounded in front, swelling out behind eyes; dorsulum short, broad, rounded and projecting in front, produced into a slight spine at extremities, and rounded behind; mesonotum somewhat large, flattened at apex, angular at extremities, and rounded behind to the broad scutellum. Legs long, femora stout; tibiæ long, slender, slightly hairy; tarsi long, slender. Wings nearly thrice as long as broad, more broadly rounded at tips than usual; primary stalk long; stalk of subcosta short; radius long, but not reaching tip of wing; upper branch of cubitus long, turning downward, upper fork longer than lower, emerging below tip of wing, with lower fork forming a small angular cell; lower branch of cubitus transverse, upper fork swelling out, rounded, lower short; clavus stout; clavical suture slight; centre of cells on hind margin indistinctly marked with the usual fine striæ. Abdomen long, slender, segments distinct. Genitalia: (♀) upper and lower valves short, coming to a point at apex, finely serrate on edges and clothed with long hairs.

Hab.—Hobart, Tasmania (on Native Musk, *Olearia* sp.: A. M. Lea).

The specimens of infested plants were received on August 12th, 1901, with a number of naked larvæ and pupæ in all stages of development clustered on the leaves of the terminal shoots, causing these to curl up at the tips; otherwise the plants did not seem to be injured.

TRIOZA TRISTANIÆ, n.sp. (Plates iv., fig. 13; v., fig. 12).

Larva light brown, with central portion darkest on dorsal surface, thickly clothed with floury secretion; flat, slightly concave, circular, fringed with very fine semitransparent filaments truncated at tips. Segmental divisions and dorsal stripe from behind; head pale yellow, eyes and antennæ hidden from above, only tips of tibiæ and tarsi showing beyond edge of shield. Ventral surface swollen, yellow. Head very small; antennæ short, stout, turned in, and just projecting beyond edge of shield; rostrum very short, brown at apex. Legs stout, swollen, tips of tarsi yellow, furnished with a circular disc at apex.

Pupa not differing from the last larval stage except in size.

Imago.—Length 0·06, antennæ 0·0175 inch. General colour: head, legs, antennæ and thorax light reddish-brown; apical third of antennæ fuscous, eyes purple, ocelli red, abdomen pale yellow. Wings transparent, nervures light brown. Head very short, but broad across, arcuate in front, lobed, a deep median suture, round at sides and deeply arcuate in centre of hind margin. Face lobes short, conical, hidden from above, clothed with hairs. Antennæ long, slender; 1st, 2nd joints short, stout; 3rd longest: 9th-10th short, thickened, rounded at apex. Eyes very large, hemispherical; lateral ocelli close to hind margin of eyes, central ocellus at base of median cleft, hidden from above. Thorax: pronotum slender and narrow at junction with head, rounded in front, truncate behind; dorsulum very prominent, convex, narrow, truncate in front, produced into a large blunt spine on sides, sloping behind to truncate apex; mesonotum large, deeply arcuate in front but swelling out on either side of dorsulum, rounded behind; scutellum large, angulated. Legs very long, slender, clothed with fine hairs, femora usually thickened, tarsi large, apical margin of tibiæ of hind pair furnished with two stout spines on inner edge. Wings long, slender, more than thrice as long as broad, primary stalk long, stalk of subcosta short; radius short, straight, coming out on upper margin of wing, forming a slender narrow pointed cell, upper branch of cubitus long, curving upward, upper fork emerging above tip of wing, lower fork below forming an angular cell; lower branch of cubitus long, upper fork large, curving round, with lower fork forming a large cell; clavus stout, clavical suture indistinct, fine striæ very distinct between cubital, and on 2nd cubital cell. Abdomen small, slender, deeply wrinkled on sides. Genitalia: (♂) short, stout, turned up over back; lower genital plate broad, rounded; forceps short, with a curved black conical tip; upper genital plate large, swollen in center, curving inward at tips: (♀) valves short, blunt.

Hab.—Gympie, Queensland (on foliage of *Tristania conferta;* W. W. Froggatt).

The larvæ produce circular, squat, funnel-shaped galls upon the leaves, sometimes scattered and single, but frequently so clustered together that the infested leaf becomes curled and aborted; many trees have nearly every leaf more or less infested. The base of the gall springs direct from the leaf, the larva being attached by its rostrum to the bottom, with the edges rising up and forming a saucer-like rim above its back, varying from pale green to yellow in colour, and measuring up to 2½ lines in diameter and 1½ in height above the leaf. At first sight, being covered with the white floury exudation, they might easily be taken for the galls of one of the Brachyscelinæ. A number of specimens were bred out in October.

Genus GEIJEROLYMA, g.n.

Head wide across, vertex produced into two slender points, closed or open at apex; face lobes wanting; antennæ long, slender.

Thorax: pronotum narrow, dorsulum very broad through centre, mesonotum and scutellum large and raised. Elytra very broad in proportion to length, curved round on front margin like a bow, rounded at apex; stalk of subcosta much longer than stalk of cubitus, subcostal cell and stigma wanting, radius long, emerging at tip of wing; cubitus short; furcations of both branches long.

The absence of face lobes places this genus close to *Tyora,* though the wings are very distinct. Type, *Geijerolyma robusta.*

GEIJEROLYMA ROBUSTA, n.sp. (Plates iv., fig. 10; v, fig. 9).

Imago.—Length 0·1, antennæ 0·07 inch. General colour bright green, with yellowish tints; antennæ and tarsi fuscous, eyes reddish-brown; wings hyaline, nervures brown. Head with eyes as broad as thorax, arcuate on summit, a distinct median suture dividing apex of vertex which is produced into elongated points taking the place of face lobes, which are wanting; fovea in line with lateral ocelli. Antennæ very long, slender, standing out in front of head; 1st-2nd joints very short, stout; 3rd very long; 4th-8th slender, decreasing in length to apex; 9th-10th slightly swollen, truncate at tip. Eyes large, semiglobular, truncate on inner margin; central ocellus at apex of median suture, lateral ocelli close to hind margin of eyes. Thorax: pronotum narrow, ribbon-shaped, dorsulum very broad in centre, rounded in front, tapering to apex; mesonotum large, slightly arcuate in front, rounded on sides; scutellum broad, produced into a point on either side of front margin, and overlapping apex of mesonotum. Legs stout, hairy: fore tibiæ long, tibiæ of hind legs swollen at apex and furnished with six stout black spines, 1st tarsal joint furnished with two smaller spines. Wings slightly more than twice as long as broad, curved on front margin, rounded at apex, and sloping in from centre of hind margin; primary stalk slender, curved upward; stalk of subcosta twice as long as stalk of cubitus; costal cell short, oval, stigma of subcostal cell wanting; radius long, turning downward, emerging at tip of wing; cubital stalk very short; upper branch of cubitus short, curving upward, upper and lower forks long, curving downward; lower branch of cubitus very short, upper fork long, curving upward and then down, lower fork almost straight, together forming a large cell; clavus small. Abdomen short, broad. Genitalia: (♂) short, broad, lower genital plate broad, rounded at tip; forceps erect, angular, broad at base; penis slender; upper genital plate slender, curving inward: (♀) upper and lower valves forming a blunt tip.

Hab.—Condobolin, N.S.W. (on Wilga, *Geijera parviflora;* W. W. Froggatt).

This species forms no lerp, but in the larval state movesabout like the members of the genus *Psylla*. The specimens examined, six in number, were obtained in the middle of October by shaking the bushes in the early morning.

EXPLANATION OF PLATES.

Plate iv.

Fig. 1.—*Rhinocola nigripennis*, n.sp.; elytron.
Fig. 2.— ,, *multicolor*, n.sp. ,,
Fig. 3.—*Aphalaria flavilabris*, n.sp. ,,
Fig. 4.— ,, *obscura*, n.sp. ,,
Fig. 5.—*Thea wellingtoniæ*, n.sp. ,,
Fig. 6.—*Spondylaspis hirsutus*, n.sp. ,,
Fig. 7.—*Psylla gracilis*, n.sp. ,,
Fig. 8.— ,, *acaciæ-juniperinæ*. ,,
Fig. 9.—*Aphalara leptospermi*, n.sp. ,,
Fig.10.—*Geijerolyma robusta*, n.sp. ,,
Fig.11.—*Triozoa dobsoni*, n.sp. ,,
Fig.12.— ,, *oleariæ*, n.sp. ,,
Fig.13.— ,, *tristaniæ*, n.sp. ,,

Plate v.

Fig. 1.—*Cardiaspis rubra*, n.sp.; elytron.
Fig. 2.—*Spondylaspis nigro-cincta*, n.sp.; elytron.
Fig. 3.—*Cardiaspis rubra*, n.sp.; vertex.
Fig. 4.—*Spondylaspis nigro-cincta*, n.sp.; vertex.
Fig. 5.— ,, ,, ,, lerp.
Fig. 6.— ,, *nigro-cincta*; vertex.
Fig. 7.—*Thea wellingtoniæ*, n.sp.; vertex.
Fig. 8.— ,, ,, ,, genitalia (♀).
Fig. 9.—*Geijerolyma robusta*; vertex.
Fig.10.—*Psylla acaciæ-juniperinæ*; vertex.
Fig.11.—*Triozoa dobsoni*, n.sp.; galls of larvæ.
Fig.12.— ,, *tristaniæ*, n.sp.; galls of larvæ.
Fig.13.— ,, *tasmaniensis*, n.sp.; galls of larvæ.
Fig.14.—*Rhinocola multicolor*, n.sp.; vertex.
Fig.15.—*Triozoa dobsoni*, n.sp.; vertex.

A SLIME BACTERIUM FROM THE PEACH, ALMOND AND CEDAR.

(*Bacterium persicæ*, n.sp.).

By R. Greig Smith, D.Sc., Macleay Bacteriologist to the Society.

During the examination of specimens of peaches affected with gum-flux, there was isolated a bacterium which produced a slime upon the surface of solid media containing saccharose. When recently separated and infected upon saccharose-potato agar, it produced a growth which, upon the 4th day at 22° C., was like a heap of diminutive white sausages, the individuals being clearly seen imbedded in a transparent jelly. After the fourth day the growth became convoluted, then flat as the slime became less viscous; the slime then slowly gravitated down the sloped agar surface. Growth was most rapid at 37° C., at which temperature the culture had the character of stiff flour-paste. The phenomenal appearance was interesting, but unfortunately for purposes of diagnosis, later cultures failed to produce the curious growth and simply developed as an uncharacteristic white, raised expansion.

A quantity of the slime was prepared by growing the organism upon plates of saccharose-potato agar, from the surface of which it was readily removed. It had a loose, pasty consistency and formed a white emulsion with water. Upon the addition of alcohol the slime was coagulated and could be strained through calico and squeezed. After the removal of the saccharose and reducing sugars, an attempt was made to separate the constituents of the slime by heating the emulsion under pressure in the autoclave, a method which had been very successful in the separation of the constituents of the arabin bacterial slimes. The attempt failed, and no separation of the gum could be induced by the method.

In view of the probable impossibility of obtaining a clear solution of the gummy constituent, the whole slime was repeatedly coagulated with alcohol until most of the salts had been removed and the bulk of the slime remained suspended in the dilute alcohol as an opalescent solution. Saline flocculating agents were then added. First potassium chloride threw down a fraction, then strong alcohol precipitated a second fraction, barium chloride flocculated a third portion. The mother liquor was now clear and bright, but on boiling off the alcohol a fourth fraction settled out. All these fractions, with the exception of the last, formed emulsions with water; the last fraction was more of the nature of a suspension. The emulsions and the suspension behaved to reagents in a manner precisely similar to the original slime and to the residue which was not "milked" by the dilute alcohol. From the similar behaviour of the fractions it was evident that the slime contained but one gum constituent. Coagulation of the emulsions was effected by alcohol, neutral and basic lead acetates, milk of lime and baryta water. These reactions were constant with the slime from the several races of the bacterium. Coagulation was also effected by other reagents, but the reactions could not be depended upon even with slimes from the same race. For example, slime grown at 37° gave a precipitate with 1 % and 10 % copper sulphate, while when grown at 18° no precipitate was obtained. With the crude slime a precipitate was obtained with ferric chloride, but the partly purified slime gave no precipitate. The ready solubility of the slime carbohydrate in dilute acids may account for the irregular behaviour with the salts of the metals.

Of more importance than the reactions of the slime is the nature of the essential carbohydrate. From saccharose, bacteria can produce dextran, levan, galactan, arabinan-galactan and derivatives of other sugars. The nature of the gum is ascertained from the sugar which it produces upon hydrolysis. The sugar is most readily determined by means of the osazones in cases of bacterial gums and slimes, when other bacterial by-products are present and when the quantity of material is usually small. The solubility, the appearance, and the melting points of the osazones are usually very characteristic.

The slime was repeatedly dissolved in water and precipitated with alcohol until a portion when hydrolysed at 70° C. with dilute hydrochloric acid showed the absence of reducing sugars. The hydrolysis of the gummy constituent was effected by boiling the slime with 5 % sulphuric acid for six hours. A slight humus-like deposit was filtered off and the sulphuric acid was removed by treatment with barium carbonate. From the clear filtrate the barium salt of an inorganic acid was removed by alcohol. The alcohol was distilled off and the solution after clarification with aluminium hydrate was evaporated to small volume. The preparation and separation of the osazones will be more readily followed from the table on the next page.

From the results set down in the table it is seen that the sugars into which the essential carbohydrate of the slime hydrolyses are arabinose and galactose. In these sugars the galactose greatly predominated, the arabinosazone having been obtained in relatively small quantity.

In slimes which are obtained by growing bacteria upon the surface of agar, there is always a danger of portions of the medium getting into the slime. When large covered dishes are used, drops of condensed water gather upon the cover and, unless removed by sloping the cover as they form, may fall into the solidifying medium, which is softened at that place and readily comes away with the slime. The traces of agar, however, which are thus accidentally gathered do not appear to influence the determination of the constituents of the slime, probably because the agar, which consists chiefly of pararabin, is not hydrolysed by boiling with 5 % sulphuric acid—at least in the time (6-10 hours)

Preparation and Separation of the Osazones.

Slime boiled with 5% H_2SO_4, neutralised with $BaCO_3$, filtered, clarified with $Al(OH)_3$, evaporated to small volume. Added 2 c.c. phenylhydrazine solution, heated on waterbath for 15 minutes, filtered through hot, wet filter, rejected tarry residue, cooled filtrate. Filtered osazone and washed with cold water.

<table>
<tr><td colspan="3">Mother liquor heated for an hour after further addition of 2 c.c. phenylhydrazine solution, cooled, filtered. Filtrate rejected. Osazone washed into beaker, diluted to 20 c.c., boiled, filtered through hot, wet filter, washed with warm water.</td><td colspan="3">Osazone washed into small beaker with 10 c.c. water, added 1 drop phenylhydrazine solution, heated for 30 min., filtered hot.</td></tr>
<tr><td rowspan="4">Filtrate cooled, filtered. Osazone with characters of arabinosazone and m.p. 158-159°.</td><td colspan="2">Osazone m.p. 175-178°.</td><td colspan="2">Osazone dried on porcelain, extracted with ether, dried at 100°. m.p. = 185°.</td><td rowspan="4">Filtrate cooled, filtered; residue dried on porcelain, extracted with ether, dried at 100°; osazone m.p. 160-163°; quantity too small to separate arabinosazone.</td></tr>
<tr><td colspan="4">These added together; the mixture was practically insoluble in boiling water; added alcohol slowly while on water bath until most of the osazone had dissolved, filtered.</td></tr>
<tr><td colspan="2">Residual osazone dissolved in hot alcohol, cooled, filtered, washed with cold dilute alcohol.</td><td colspan="2">Filtrate cooled when osazone separated out, filtered.</td></tr>
<tr><td>Osazone m.p. 193-194° with characters of galactosazone.</td><td>Boiled off alcohol from filtrate, filtered; residual osazone m.p. 193-194° with characters of galactosazone.</td><td>Osazone m.p. 191-192°.</td><td>Filtrate boiled to expel alcohol, residue obtained m.p. 171-173°; quantity too small to separate further.</td></tr>
</table>

usually occupied in hydrolysis. I have tested the hydrolysed products of a glucose-yielding slime grown upon agar and have failed to detect arabinose. The probability of the agar contributing to the products of the hydrolysis of this slime is therefore remote.

The slime can also be obtained, though in comparatively small quantity, by growing the bacterium in fluid media containing saccharose. A solution containing saccharose 50, peptone 2, ammonium chloride 1, potassium phosphate 1, magnesium sulphate 0·5, chalk 10, and water 1000 was prepared, and after sterilisation and infection with the organism, it was kept at the laboratory temperature (22-25°). In 10 days the medium had become ropy and had the consistency of white of egg. The opalescent, supernatant liquid *which strongly reduced Fehling's solution*, showing the presence of invertase, was decanted from the sediment, tested with a few drops of hydrochloric acid and finally coagulated with alcohol. A stringy coagulum which rapidly collected round the stirring rod and a slow settling flocculent precipitate were formed. The coagulum was separated from the flocculent precipitate and both were repeatedly treated with water and with alcohol until the sugars had been eliminated. The characters of the alcoholic precipitates were maintained throughout these operations, and upon treating the precipitates with water a gummy solution and an insoluble swollen portion was always obtained. The soluble gum of both portions behaved similarly in being coagulated with or precipitated by the basic and neutral acetates of lead, baryta water and milk of lime, so that the gums were apparently identical. There was a difference in the viscosity of the solutions; that obtained from the coagulum was always more viscous than that obtained from the flocculent precipitate. In spite of this the amounts of the precipitates formed upon the addition of the reagents were greater in the solution from the flocculent precipitate than in the solution from the coagulum. The increased viscosity of the solution which appeared to contain more gum was probably due to the presence of a greater quantity of the albuminoid products of the bacteria.

By using aluminium hydrate a clarification of the gummy solutions was effected, and although this reagent also removed some of the gum, yet the clear solutions were still viscous. These solutions were neutral to litmus paper, and upon being tested were found to be inactive to polarised light.

The slime thus obtained in saccharose solutions, and therefore free from any admixture with agar, was hydrolysed with dilute sulphuric acid after all saccharose and reducing sugars had been eliminated. The crude osazone was extracted with ether and then dissolved in 85 % alcohol to remove an unhydrolysed product. The osazone obtained upon evaporating the alcoholic solution to dryness melted at 181-182° and appeared microscopically to consist of two kinds of crystalline groups, one being pale yellow, the other dark yellow in colour. Hot water extracted a constituent which upon evaporation appeared as a brown deposit and which melted at 158-159°, the melting point of arabinosazone. Thus arabinose is proved to be a constituent of the hydrolysed carbohydrate and was not in the former tests derived from the agar upon which the slime was produced.

The gum is one of those soluble kinds which readily become altered to an insoluble modification upon drying or by the action of dehydrating agents such as alcohol. The insoluble modification is soluble in dilute acid and insoluble in dilute alkali. It is therefore akin, so far as the solubility is concerned, to the metarabin and pararabin gums. But unlike these gums, it is not readily converted from the insoluble to the soluble modification, and cannot therefore be of any direct commercial importance.

The bacterium undoubtedly contributes a part of the natural gum of the plants in the tissues of which it occurs, but the part is so small as to be almost negligeable. I obtained some almond gum from Mr. Stoward, of Adelaide, and removed the soluble arabin by soaking the gum in water and filtering. The insoluble metarabin was dissolved by heating under pressure, and after acidification with hydrochloric acid the gum acids were precipitated with alcohol. The acid alcoholic solution was then neutralised with sodium hydrate, when a precipitate settled out. This was treated with water and filtered. The solution, which was neutral to litmus, was coagulated by alcohol and precipitated by barium hydrate (not by barium chloride), neutral lead acetate and basic lead acetate. These precipitates were curdy, like other gum precipitates, and when considered in conjunction with the method of separation (*i.e.*, the solubility of the carbohydrate in acid alcohol) show that the constituent had been produced by the bacterium.

Hitherto the slime had been formed on media or in solutions containing saccharose without which no pronounced formation of slime occurred. Other sugars and carbohydrates had not, however, been tested, and therefore experiments were made to determine what other substances could replace saccharose. To dilute potato-extract agar, simple peptone agar and ordinary nutrient agar, small quantities of the following substances were added: saccharose, levulose, dextrose, galactose, maltose, lactose, raffinose, mannite, starch, inulin, dextrin and glycerine. The potato-extract medium did not give results so sharply as the ordinary nutrient agar, probably because that medium contains reducing sugars and other substances that assist gum-formation. They, however, served to corroborate the results obtained with ordinary meat-extract-peptone agar and simple peptone agar. Slime was produced from all the substances except lactose, starch and inulin.

Carbon dioxide was imperceptibly evolved during the slow fermentation of saccharose. Its presence in the air of the culture flask was shown by drawing the air above a 5 days' culture through baryta water contained in an attached flask. The usual precautions were taken to exclude aerial carbon dioxide when the medium was infected, and it is needless to say that carbonates were absent from the medium.

The acids that are produced from saccharose simultaneously with the gum were found to consist chiefly of lactic and butyric, with traces of succinic, acetic and formic. The ratio of volatile to non-volatile acids was as 1 : 4. The acids were detected by the scheme which has already been described.*

Ethyl alcohol is also a by-product in the fermentation. A few drops were obtained by repeatedly distilling the fluid of a chalk culture after it had been saponified with barium hydroxide. The alcohol gave the iodoform reaction, burned with a blue flame and boiled at 78° C.

The organism is a non-motile, spore-bearing bacterium, and beyond the formation of slime and the secretion of invertase it has no distinctive characters. It may be related to *Bac. mucosus*, Zimm., or to *Bact. glutinosum*, Kern, but as the formation of a similar gum or slime by these bacteria has not been described, and as this is the chief and important characteristic of the bacterium, it must be accepted as new until such time as it is proved that other bacteria with approximate cultural characters can produce a chemically identical gum. Since the organism was in the first instance obtained from the peach, I have named it *Bacterium*† *persicæ*.

Although obtained originally from the peach, it may occur in other fruits and plants. A race which when freshly isolated produced a spotted instead of the sausage appearance upon saccharose-potato agar was obtained from a specimen of red cedar, *Cedrela australis*, F.v.M., affected with gum-flux. Another race which produced a homogeneous white slime was found in almonds which were exuding gum. These races had slight differences when grown upon various media, and in the list of cultural characters which is appended these differences are indicated.

BACTERIUM PERSICÆ, n.sp.

Shape, &c.—Thick large spongy rods with rounded ends generally grow in chains; occasionally a few clostridium forms are seen. The size of the individual rods are 1·2-1·5 : 3-6 μ; as observed in the hanging drop, they measure 1·5 : about 7·5 μ.

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* These Proceedings, 1903, i., 118-120.

† According to Migula's classification.

The rods are devoid of motility, and no flagella could be detected. The spongy rods are decolorised in places by the Gram method. The spores are central and oval, and measure 1 : 1·5 μ; germination is polar.

Temperature, &c.—The bacillus grows equally well at 30° and 37°, at 15° and 22° the growth is less. It is aërobic and does not grow under anaërobic conditions such as beneath a mica sheet in plate culture.

Nutrient agar plate.—The colonies in 24 hours at 30° are white, raised, dry and rounded. Microscopically they are clouded and hatched. The deep colonies are opaque, irregular and fibrous. Upon the second day the margin of the colony has become puckered, and microscopically the colonies appear granular, with a margin like a yeast colony.

Saccharose-potato agar plate.—At 22° the colonies are in 48 hours translucent white and raised. They become white, appearing like drops of flour paste, and when free to grow soon reach a centimetre in diameter. Microscopically the translucent white colonies are either clouded or opaque. The deep colonies are irregular and opaque.

Nutrient gelatine plate.—The colonies consist of a white felted or floccose mass in a crateriform liquefied area. The deep colonies are irregular, rough and opaque.

Nutrient agar stroke.—The growth is raised, white or buff-white, dry, glistening or fatty, lobular and rough, with microscopic puckerings. It becomes broad and translucent, the roughness disappears and the culture becomes flat and speckled. The edge is at first smooth, but becomes ciliate and the medium darkens.

Saccharose-potato agar stroke.—A very luxuriant white or dirty white slime is formed. It slowly gravitates, generally producing vertical furrows. At 22°, and when recently isolated, the growth may show a sausage-like, wisp-like or wrinkled structure which becomes homogeneous.

Nutrient gelatine stab.—The growth is faint and filiform below, with a tubular liquefied area above and an air bubble at the top.

The liquefied area becomes napiform and shows clear, opalescent and white portions.

Glucose-gelatine stab.—The medium is partly consumed and partly liquefied, showing an air bubble and a crateriform liquefied area bearing a film. The needle track below the liquefied area is white and filiform. The liquefied area becomes funicular and the sunken film becomes wrinkled. No gas is produced in the body of the medium.

Potato.—The growth appears as white or yellow-white, dry, dull or glistening crusts; these fuse together to form a wrinkled expansion which ultimately becomes pasty.

Bouillon.—The medium is clear or faintly turbid; a loose flocculent deposit and broken surface ring is formed. The indol reaction was obtained. In nitrate-bouillon, the nitrate is not reduced.

Milk.—The medium is partly, then completely peptonised, the reaction being faintly alkaline. The milk is not made ropy.

Summary.—From the peach, the almond and the cedar, races of an organism, *Bacterium persicæ*, n.sp., were separated. The organism produced a slime when grown upon solid media or in fluid media containing saccharose. When grown upon solid media the saccharose could be replaced by many other carbohydrates and by glycerine. The essential carbohydrate of the slime was soluble in water, but upon drying became readily altered to an insoluble modification. The carbohydrate hydrolysed to arabinose and galactose, the latter predominating. The carbohydrate occurred in small amount in the gum exuded from one of the trees in which the organism was found. Besides forming the galactan-arabinan gum, the organism inverted the saccharose and produced ethyl alcohol, carbon dioxide, lactic, butyric and traces of succinic, formic and acetic acids.

Although the carbohydrate hydrolyses to arabinose and galactose, I do not consider that it belongs to the arabin group. The gums of this group are, by treatment with water in the autoclave at three atmospheres' pressure, readily and completely dissolved. I have found this to be the case with metarabin and with pararabin (as I shall show in a subsequent paper), and of course it holds for the soluble arabin. I do not wish it to be inferred that this behaviour is peculiar to the arabin gums. It is not, for as I have shown, the gum of *Bact. sacchari* is dissolved by the treatment and this, as I shall show in a future paper, is a gelatine gum. But on account of the divergence from the recognised members of the group I have not included this paper in my series of papers upon "The Bacterial Origin of the Gums of the Arabin Group."

A REVISION OF THE EUCALYPTS OF THE RYLSTONE DISTRICT.

By R. T. Baker.

In a paper published in the Society's Proceedings for 1896 "On the Botany of Rylstone and the Goulburn River Districts," I recorded a list of Eucalypts collected by me up to that date. Since writing that paper I have several times visited the district and made botanical collections, so that my knowledge of the Eucalypts has considerably increased, and consequently I find that my previous views of these trees have somewhat altered, and in some cases I am not prepared to stand by my original determinations.

I wish now to modify some of my previous statements respecting certain species, to add new data regarding others, and also to re-arrange the species in a sequence founded on a classification which is not so restricted as that based on morphology alone.

The system now followed is that advanced by myself and colleague, Mr. H. G. Smith, in the work "Eucalypts and their Essential Oils." It is based on—

(1) A field knowledge of the trees,

(2) The nature and character of their barks,

(3) The nature and character of their timbers,

(4) Morphology of the fruits, leaves, buds, &c.,

(5) Chemical properties and physical characters of the oil, dyes, kinos, &c., and any other evidence, such as histology, physiology, &c.

Such a classification, we think, is a nearer approach to a natural one than any of the other systems yet devised.

The range of several species is also considerably extended.

I have to acknowledge my indebtedness to Mr. James Dawson, L.S., Surveyor for the District, where he has now been stationed over 25 years and whose knowledge of its Eucalypts is considerable, for kindly assisting me with many valuable field observations.

The geological formation of this district is very interesting, and I regret that I have not given more attention to the subject, as there appears to be a very close connection between particular species of Eucalypts and the soil. For instance, *E. lævopinea* is only found on certain disintegrated igneous ground, and *E. Dawsoni* on a certain stratum below the sandstone of the Tomago Beds.

E. TRACHYPHLOIA, F.v.M. "Bloodwood."

No additional notes to those already given are available, as I have never found it in any but the one locality recorded.

E. LÆVOPINEA, R. T. Baker. "Silvertop Stringybark."

This tree was first made known to science by me from material obtained on the Gulf Road and recorded under the name of *E. obliqua* in my first description of the Rylstone botany

I have since seen trees of the true *E. obliqua* in Tasmania, as well as in Victoria and this Colony, and am quite convinced that my previous determination was altogether wrong, through having laid too much stress on the shape of the leaves, for after describing the fruits as distinct from *E. obliqua*, I state "the shape of the leaves corresponds in every particular with all the descriptions and figures published of *E. obliqua*." I doubt now whether it is ever found on the same geological formation as *E. obliqua*, for it occurs just below or on the summit of basaltic hills or mountains (J. Dawson). I think there can be no question now about its being a distinct species, for it possesses too many systematic and economic characters to be merged into any other. Nevertheless it should be mentioned that this view does not commend itself to some systematists (*vide* these Proceedings, 1896, p. 803; 1898, pp. 28 and 798; 1901, p. 124; and also

Maiden's 'Critical Revision of the Genus *Eucalyptus*,' where it is placed under five different species).

E. lævopinea differs from—

- (*a*) *E. capitellata* in the shape of its fruits, its timber, bark and oil constituents.
- (*b*) *E. macrorhyncha*, in its fruits, timber, leaves, bark, oil constituents, leaf dye.
- (*c*) *E. pilularis*, in its leaves, particularly in the dried state, buds, leaf venation, timber and oil constituents.
- (*d*) *E. Muelleriana*, in timber, leaves, fruits, bark and dye of inner bark.
- (*e*) *E. dextropinea*, in its timber (worthless), leaves, fruits, buds, and oil constituents.

E. LACTEA, R. T. Baker. A "Spotted Gum."

Not previously recorded for this district. The "sucker" leaves readily distinguish it from *E. viminalis*, Labill., or *E. maculosa*, R. T. Baker. It is common on Mount Vincent, and some typical trees occur on the main Western Road, Blackheath, and main Southern Road in the Bargo Brush, as well as at O'Connell, near Brewongle.

It is therefore a tree with a fair range as far as at present known. The timber is of poor quality.

E. CONICA, Deane & Maiden. "Box."

In my original paper this was recorded as *E. hemiphloia*, F.v.M., from a casual field observation, but since receiving full material for oil investigation I am convinced that the tree is no other than that of Deane & Maiden's species. Mr. Maiden, in these Proceedings, synonymises it with *E. Fletcheri*, R. T. Baker, which he also records as *E. Baueriana*, of Schauer, whose type specimens consists of leaves and buds only.

I fail to follow Mr. Maiden's line of argument in these Proceedings 1902, p. 216, concerning the phyto-chemical affinity of this species with that of *E. ovalifolia*, R. T. Baker; nor have these two species anything in common morphologically, and their timbers and bark are quite distinct.

E. EUGENIOIDES, Sieb. "White Stringybark."

Fairly general throughout the district.

E. ROSSII, R. T. Baker & H. G. Smith. "Spotted Gum."

This tree I previously recorded under the name of *E. hæmastoma* var. *micrantha*. It has been found, however, that it possesses such distinctive characters from that species that it has already been given specific rank under the above name.

The timber is very hard, red-coloured and durable, and is far superior to that of *E. hæmastoma*, with which it has been synonymised by various authors working on dried material.

Camboon is the only locality I have collected it.

E. DEALBATA, A. Cunn. "Mountain Gum."

This species, for some reason not clear to me now, I recorded under the name *E. Gunni*, Hook. f. It is well distributed in the district, and its occurrence so far east as Murrumbo is, I think, a record for this interior Eucalypt.

E. MACULOSA, R. T. Baker. A "Spotted" or "Brittle Gum."

This species is common on dry, sandstone ridges of the western slopes of the Main Dividing Range, particularly at Mount Vincent, Ilford. The timber is poor and of little value even for firewood.

E. CAMPHORA, R. T. Baker. "Sallow."

I am now convinced that my original determination, *i.e.*, *E. dealbata*, was entirely wrong in regard to this Eucalypt, and that this species has little to connect it with that species.

I have since recorded it under the name of *E. camphora* from this as well as localities far removed from Rylstone. Deane & Maiden express an opinion (these Proceedings, 1901, p. 137) that it is identical with *E. ovata*, Labill., concerning which species Bentham, who had access to all the European herbaria, states

(B.Fl. iii. p. 200), "*E. ovata*, Labill., Pl. Nov. Holl. ii. 13, t. 153, from West Australia, does not occur in the distributed sets of Labillardière's plants which I have seen. From the figure, it appears probable that the specimen represented was from an adventitious branch, with much broader leaves than the ordinary flowering ones. It is very likely, therefore, a form of some one of the described Western species, possibly *E. brachypoda*." Labillardière gives a good plate of his *E. ovata*, collected near or on the coast at Cape Leeuwin, Western Australia, and it will no doubt yet be identified with a Eucalypt from that State.

This botanist could not possibly have collected *E. camphora* in his time, as its now known habitat was inaccessible in his day, and the species common to Eastern and Western Australia are all interior ones, whilst *E. ovata*, Labill., is coastal. Labillardière faithfully figures some particular species, but it certainly is not my *E. camphora*, which has quite different flowers, leaves and fruits.

E. PUNCTATA, DC. "Grey Gum."

I find now that two species were included under my original notes, viz., the true *E. punctata* occurring at Mount Vincent, and *E. squamosa*, Deane & Maiden, under the name of "Ironwood" at Kelgoola. Grows under the sandstone cliffs (J. Dawson).

E. SQUAMOSA, Deane & Maiden.

Some very tall trees of this species occur at Kelgoola under the name of "Ironwood."

E. BRIDGESIANA, R. T. Baker. "Woolly-butt."

Originally recorded by me as *E. Stuartiana*.

E. GONIOCALYX, F.v.M. "Mountain Gum."

Not previously recorded, but it is a common tree in the Never Never country and Kelgoola. In the gullies radiating from Mt. Corricudgy it is very plentiful, and some enormous trees await the timber-getter.

E. GLOBULUS, Labill. "Blue Gum."

This species is common in the gullies of Never Never, *via* Kelgoola.

E. CAMBAGEI, Deane & Maiden. "Woolly-butt."

Occurs as far west as Hargraves. It has a "Box" bark and a timber (quite worthless) similar to trees of this species occurring in Victoria and other parts of New South Wales. It is a very constant species.

E. MELLIODORA, A. Cunn. "Yellow Box."

This tree, like so many other Eucalypts, preserves in a marked degree its specific characters throughout the Rylstone District, where its representatives are identical with those found in Victoria and other parts of Australia.

E. DAWSONI, R. T. Baker. "Slaty Gum."

Found only on the eastern slopes of the Main Dividing Range in the watershed of the Goulburn River and always on the same geological formation, viz., the Tomago Beds. It is never confounded by settlers with the "Red Box," *E. ovalifolia*, nor is it to be expected when it is remembered that these people never confuse a smooth-barked (Gum) tree with a "Box"-barked tree. Its timber is excellent and quite equal to Ironbark (*vide* note below). It also occurs in Capertee Valley (J. Dawson).

E. OVALIFOLIA, R. T. Baker. "Red Box."

A well distributed species in this State, but in this district is found on rather poor soil. As a rule the bark is smooth, but occasionally a rough bark occurs a few feet from the ground.

It is never so tall as "Slaty Gum," *E. Dawsoni*, and its timber is little sought after owing to its curly nature and pipy stem. The poorer the ridge the worse the timber (J. Dawson). I fail to follow Mr. Maiden's line of argument in these Proceedings, 1902, p. 529, that there exists a phyto-chemical affinity between *E. conica* and this specimen, and the statement that I mixed the material sent to him is incorrect.

E. OVALIFOLIA, R. T. Baker, var. LANCEOLATA, R. T. Baker & H. G. Smith. "Red Box," "Slaty Gum."

This tree very probably owes its differentiation to environment, for I have only found it in rich, moist soil. It has a smooth bark, lanceolate leaves (broader than *E. Dawsoni*), and an excellent straight-grained, comparatively soft, red timber; in other respects it resembles the type. At Lue and along the banks of the streams that flow into the Cudgegong on its right bank from Rylstone to Gulgong, it is sometimes known as "Slaty Gum" (J. Dawson), but it is not the "Slaty Gum" of Bylong upon which *E. Dawsoni* was founded.

REMARKS ON THE ABOVE THREE EUCALYPTS.

These were originally placed by me as varieties of *E. polyanthema*, Schauer, but during the last five years much in the way of new data has been collected concerning them, so that I have been led somewhat to alter my first classification, and I now regard them as quite distinct from that species and have so recorded them in these Proceedings.

E. polyanthema, Sch., has recently (Proc. Linn. Soc. N S.W. 1902, p. 527) formed the subject of a paper by Mr. J. H. Maiden, who reproduces Schauer's original description from Walpers' 'Repertorium,' and also gives a figure drawn from the type specimen.

This description and figure refer to a tree that in no way can be made to include any of the above trees, although Mr. Maiden synonymises them with it (Schauer's *E. polyanthemos*). I have in my possession botanical material identical with those of Schauer's, in fact might be thought to be the type figured, and these are from a tree quite distinct from any of the above three. Schauer states of his tree, "*Arborea glauco-virens; foll. coriaceis ovatis subito in petiolum contractis obtusis apiculatis, margine crasso subrevoluto cinctis impunctatis, utrinq. opacis.*"

Such features are not to be found in either *E. Dawsoni*, *E. ovalifolia*, or *E. ovalifolia* var. *lanceolata*, and one has only to know these trees in the field and to compare their herbarium specimens with the type figured by and in possession of Mr. Maiden, to at once see how much the morphological differences are emphasised and therefore how absolutely distinct they are from Schauer's description and Cunningham's specimens. Although I am strongly opposed to laying much importance on fragmentary type specimens—in this case only leaves and buds are preserved, yet the slightest inspection will prove conclusively that these differ materially from the leaves and buds of the above three species.

The type delineated by Mr. Maiden exactly matches the "Grey Box" of Victoria—the "Red Box" of the southern interior and south-east corner of N.S.W., and the interior of N.S.W. west of the town of Bathurst, also the species figured by Mueller in his 'Eucalyptographia,' and whose description is that of a tree *with a "Box" bark extending right out to the branchlets,*—one point of distinction which is worthy of some attention in systematic work, but apparently has been entirely ignored, and which, I contend, should have been taken into account in this connection when synonymising. It is this tree that has been recognised as *E. polyanthema* in the work 'A Research on the Eucalypts.' It is a similar case to *E. goniocalyx* and *E. elæophora*, F.v.M., which species, till pointed out by me, were considered by some as one and the same tree, and as this latter species can be easily separated from Mueller's description of the former, so "Grey Box" of Victoria and the "Red Box" of N.S.W. with their persistent "Box" bark, can thus be separated from the *smooth-barked* Eucalypts recorded by Mr. Maiden under *E. polyanthema*. It is worthy of passing note that Mr. Maiden states:—

(1) "Tumut, H. Deane. Mr. Deane has the following note: 'Deciduous, *smooth* bark; var. *E. polyanthema*. Same as 'Red Box' from Queanbeyan apparently."

Evidently Mr. Deane was not prepared to place this tree with its smooth bark in the same specific rank as the tree with a "Box" bark, *E. polyanthema*, but gives it varietal position. I have seen these trees, and they are identical with the Rylstone Red Box, *E. ovalifolia*, and also show a constancy of bark over a large area.

(2) "Red Box," Reedy Creek, near Gulgong, "*narrow leaves*," big trees, glaucous all over (J. S. Boorman).

The leaves illustrated by Mr. Maiden as Schauer's type are certainly not *narrow*, and this one feature alone is sufficient to indicate a change of species from that of the type, whilst these "big trees, glaucous all over" are certainly not *E. polyanthema*, Schauer, as such an expression could not apply to a "Box"-barked tree. I think these two instances alone will suffice to show to what extremes morphologists of the Muellerian school are prepared to go in uniting species.

Mr. Maiden further states, p. 528, "he found people indifferent as to the use of the names 'Slaty Gum' or 'Red Box,' applying them indiscriminately as a very general rule." This is not the experience of myself nor that of Mr. Dawson, who is thoroughly acquainted with the whole Rylstone district.

The variety *lanceolata* is, in my opinion, a good definition of a variety. Its bark and oil are somewhat similar to the type, whilst it differs from it in the nature of its timber, and in the shape of its leaves and fruits.

The following table will prove conclusively the specific morphological differences of these Eucalypts, and although these are so well marked, the phyto-chemical ones are still more so.

1. *E. polyanthema.*—Leaves ovate, *coriaceous*, obtuse, apiculate, margins thick, subrevolute, venation distinct, intramarginal veins *well removed from the edge*, oil glands hidden. Timber hard, close-grained, red-coloured. Bark "Box" throughout. Buds 2 to 3 lines in diameter, hemispherical to conical, contracted in the centre, pedicellate; operculum obtuse. Fruits conical, edge thin, notched, 2 to 3 lines in diameter. Oil constituents, eucalyptol, pinene, sesquiterpene, esters. *Hab.*—Victoria, N.S. Wales (Albury, Gerogery, Pambula, Bungendore, Delegate River, country west of Bathurst).

2. *E. Dawsoni.*—Leaves lanceolate, glaucous, thin, intramarginal vein *close to the edge*, oil glands distinct. Timber deep red-coloured, hard, similar to Ironbark, straight in the grain. Bark deciduous, slate-coloured or white, smooth. Buds

1 line in diameter, sessile or gradually tapering to the base, glaucous; operculum obtuse. Fruits small, 1 to 1½ lines in diameter, hemispherical or elongated, glaucous. Oil constituents, phellandrene, sesquiterpene. *Hab.*—Eastern watershed, Goulburn River Valley (Tomago Beds).

3. *E. ovalifolia.*—Leaves thin, ovate-lanceolate, venation distinct, intramarginal vein removed from edge, oil glands distinct. Timber curly, red, hard, but not used as trees are always decayed in centre. Bark smooth or rough at the base for 2 or 3 feet. Fruits conical, pedicellate, rim thin, contracted at edge. Oil constituents, phellandrene, pinene, sesquiterpene. *Hab.*—Western watershed of Rylstone District, Tumut, Hargraves.

4. *E. ovalifolia* var. *lanceolata.*—Leaves *thin*, lanceolate, intramarginal vein close to edge, oil glands distinct. Timber excellent, red-coloured, durable, straight in the grain. Bark deciduous, smooth, white. Fruits similar to 3, except not contracted at edge. Oil constituents, phellandrene, pinene, sesquiterpene. *Hab.*—Western watershed N.W. of Rylstone.

E. MACRORHYNCHA, F.v.M. "Red Stringybark."

Through an error in my field notes, the remarks in regard to the quality of the timber given under this species refer to that of *E. eugenioides.* The timber of *E. macrorhyncha* is not considered good, and is only used when that of other "Stringybarks" is not available.

E. TERETICORNIS, Sm.

Previously the opinion was expressed that this Eucalypt "might be placed with *E. viminalis,*" but I do not think so now.

The trees at the foot of the Nulla Mountain have a very long narrow operculum and correspondingly long narrow calyx.

The timber is considered good and durable.

It has an extensive range in the district.

E. ALBENS, Miq.

As this tree is very distinct over a large area of country, I am still inclined to regard it as worthy of distinction from *E. hemiphloia,* F.v.M., as formerly stated. Also found in the Capertee Valley (J. Dawson) and Hargraves (R.T.B.).

E. VIMINALIS, Labill.

The name "Brittle Gum" given amongst others to this species in the original Census has since been separated by me under the name of *E. maculosa.*

Occurs near most watercourses or low-lying land.

E. CAPITELLATA, Sm. "Brown Stringybark.

I previously expressed an opinion that an apparent gradation exists between this species and *E. eugenioides.* These gradations I find upon further investigations are not so pronounced as originally appeared to be the case. The fruits show a variation, being sometimes hemispherical and slightly pedicellate and at other times sessile and with compressed sides.

E. HÆMASTOMA, Sm. "Scribbly Gum."

The trees at Coomber and Ilford have a large fruit with a red rim and thick coriaceous leaves, and so, closely match the Sydney trees which I regard as Smith's type.

E. SIDEROXYLON, A. Cunn., var. PALLENS, Benth. "Ironbark."

This species or variety has always appeared to me to present a difficulty in systematically placing, as its flowers and fruits are identical with those of *E. sideroxylon*—morphological characters that cannot be ignored by any systematist, and yet it possesses distinctive foliage, timber and bark. I am sometimes inclined to think it is the "Rotten Ironbark" mentioned by Cunningham in Field's 'New South Wales,' published in 1825, as that vernacular name fittingly describes the timber.

E. CREBRA, F.v.M. "Narrow-leaved Ironbark."

A well distributed species in the district. Very plentiful at Murrumbo on the Goulburn River.

E. SIDEROPHLOIA, Benth. "Ironbark."

I regret that no additional material has been obtained to assist in the further elucidation of the trees placed by me under this name, as the trees occur on ranges most difficult of access. The fruits and buds are sessile and far more angular than pertains to the Sydney form, and the operculum is also much more obtuse.

E. PIPERITA, Sm. "Peppermint."

Both varieties of this Eucalypt, *i.e.*, those with the urn-shaped fruits and those with the pillular ones, are found to occur indiscriminately. Only one locality was originally given, but I have since found it at Cudgegong, Kelgoola, Rylstone, and Corricudgy Ranges.

E. AMYGDALINA, Labill. "Peppermint."

Only one locality is given in the original paper, but it occurs also in most of the hills or ranges in the immediate neighbourhood of Rylstone.

E. CORIACEA. "Cabbage Gum."

Not previously recorded, but common on sandstone ridges near Ilford.

E. SIEBERIANA, F.v.M. "Mountain Ash."

Not previously recorded. This species attains giant dimensions at Never Never and Kelgoola.

E. DIVES, Schauer. "Peppermint."

Not previously recorded. Kelgoola to Mount Vincent and south to Wallerawang. It has much the same habit as those at Mittagong on the Southern line, and although some very large trees are to be found, the timber is considered worthless.

E. STELLULATA, Sieb. "Lead Gum."

This species occurs in the Capertee Valley as well as in the ranges west of it, as previously stated. This difference in altitude does not appear to produce any specific changes.

NOTES AND EXHIBITS.

Mr. W. S. Dun exhibited a well preserved specimen of the coalesced basal plates of *Phialocrinus Konincki*, collected at Mt. Vincent, in the Upper Marine Stage of the Permo-Carboniferous. The specimen is interesting from the fact that on the inner surface it shows the well-marked junction of the five basal plates, a structure that is not visible on the outer aspect. This is a point that has not been observed before. The specimen was collected by Mr. Eustace Wilkinson.

Mr. Gurney showed three living specimens (♀) of *Extatosoma tiaratum*, W. S. Macleay, one of the "Leaf Insects" (*Phasmidæ*), with newly laid eggs, and larval forms in various stages of growth one of them just hatched from the egg. The insects are not uncommon in certain parts of Northern New South Wales on the native scrub; but the specimens exhibited were forwarded from the Brunswick River, with the information that they were attacking the foliage of fruit trees, particularly that of the Plum, a change of food-plant not previously recorded. As the insects reposed on a pot-plant, attention was called to the protective mimicry afforded, more especially, by the flat leaf-like expansions along the sides of the abdomen and the legs.

Mr. Fred. Turner exhibited a very fine series of Australian grasses, collected on Glenariff Station, viâ Byrock, a little east of the Darling River, comprising the following twenty-eight species:—*Amphibromus neesii*, Steud.; *Amphipogon strictus*, R.Br.; *Andropogon bombycinus*, R.Br.; *A. sericeus*, R.Br.; *Anthistiria avenacea*, F.v.M.; *A. ciliata*, Linn.; *Aristida behriana*, F.v.M.; *A. stipoides*, R.Br.; *Chloris truncata*, R.Br.; *Cynodon dactylon*, Pers.; *Danthonia bipartita*, F.v.M.; *Diplachne fusca*, Beauv.; *Eleusine ægyptiaca*, Pers.; *Eragrostis eriopoda*, Benth.; *E. laniflora*, Benth.; *E. pilosa*, Beauv.; *Eriachne obtusa*, R.Br.; *Neurachne* *alopecuroides*, R.Br.; *N. mitchelliana*, Nees; *Panicum decompositum*, R.Br.; *P. distachyum*, Linn.; *P. effusum*, R.Br.; *P. gracile*, R.Br.; *P. leucophæum*, H.B. et K.; *P. mitchellii*, Benth.; *Pappophorum nigricans*, R.Br.; *Sporobolus virginicus*, Kunth, var. *pallida*; and *Stipa setacea*, R.Br. All the specimens showed remarkable growth, but the two most luxuriant forms were the "oat grass" (*Anthistiria avenacea*, F.v.M.), attaining a height of 6 feet 4 inches, and the "Kangaroo grass" (*A. ciliata*, Linn.), 4 feet 10 inches. This growth had been made in about four months and, therefore, was green, rich and succulent. The economic value of each species, its geographical distribution, and special characteristics were pointed out.

Dr. Greig Smith exhibited cultures of a slime-producing organism, together with specimens of slime, in illustration of his paper. He also showed a quantity of slime, 200 c.c., produced by growing *Bact. sacchari*, Greig Smith, upon 10 plates of tannin-glycerine-potato-agar, each containing 100 c.c. of medium.

Mr. Froggatt showed a collection of the Psyllids described in his paper.

Mr. Baker exhibited a series of herbarium specimens and timbers in illustration of his paper. Also an apparently roughly dressed, sub-cylindrical stone, about 18½ inches long, and from 2-3 inches in diameter, recently found by Mr. W. Bäuerlen in the bed of Bushrangers' Creek, near Wellington, N.S.W. It is believed to be another example of the curious Aboriginal Ceremonial Stones, or whatever else they may have been, to which attention has already been called by Mr. W. R. Harper in the Society's Proceedings (1898, p. 420).

Mr. J. J. Walker remarked that a similar stone had been given to him at Tanna, New Hebrides, where it was said to be used as a weapon of war to be hurled at the legs of an enemy.

Dr. Hamlyn-Harris, a visitor, on the invitation of the President, recounted some personal experiences of the phenomena attending the fall of volcanic dust in the island of Barbadoes last year, consequent upon the outbreak in St. Vincent. A sample of the dust which fell during the outbreak of March, 1903, was exhibited.

The Secretary exhibited and handed over to the Society, on behalf of Mr. Syms Covington of Pambula, N.S.W., another interesting relic of the Voyage of the "Beagle," which had been forwarded to him by Mrs. Forde, on the donor's behalf. This was Charles Darwin's pocket compass, or rather a combined compass and universal sun-dial. The latitude arc is divided to two degrees only, and the hour circle to 30 minutes, while the compass shows only the cardinal points. The style is vertical to the hour circle, which is hinged for latitude adjustment. The instrument when not in use folds into a rough wooden case, 3¼in. x 2¾in., which shows signs of much wear. The exhibit was received with great interest. The cordial thanks of the Society have been tendered to Mr. Syms Covington, and also to Mrs. Forde.

Mr. Fletcher also showed a fresh specimen of *Busaria spinosa*, Cav., from Gladesville, playing the very unusual part of host to a species of *Loranthus*, not sufficiently mature for determination.

WEDNESDAY, JUNE 24TH, 1903.

The Ordinary Monthly Meeting of the Society was held in the Linnean Hall, Ithaca Road, Elizabeth Bay, on Wednesday evening, June 24th, 1903.

Dr. T. Storie Dixson, President, in the Chair.

The Donations and Exchanges received since the previous Monthly Meeting, amounting to 7 Vols., 75 Parts or Nos., 9 Bulletins, 5 Reports, 13 Pamphlets, 4 Miscellanea, and 2 Maps, received from 55 Societies, &c., and 1 Individual, were laid upon the table.

THE CORPUS LUTEUM OF *DASYURUS VIVERRINUS*, WITH OBSERVATIONS ON THE GROWTH AND ATROPHY OF THE GRAAFIAN FOLLICLE.

By F. P. Sandes, M.D., Ch.M. (Syd.).

(Communicated by Professor J. T. Wilson, M.B., Ch.M.).

(Plates vi.-xx.)

Introduction.

For the past seventy-five years the exact mode of origin of the structure known as "Corpus Luteum" has been the subject of dispute. The series of changes which take place in the wall of of the evacuated Graafian follicle and result in the formation of the corpus luteum has been studied in different animals with varying degrees of completeness. Considerable uniformity underlies the process in those animals in which this particular question has been studied, but different significances have been attached by different observers to a series of changes essentially similar. Briefly, it may be stated that some maintain that the corpus luteum originates from the membrana granulosa of the Graafian follicle, whilst others refer its origin to the wall of the follicle or theca folliculi. The writer of this paper has attempted to throw light upon the subject by observing the growth of the corpus luteum in the ovary of a small marsupial found in abundance in various parts of Australia, namely, the Native Cat (*Dasyurus viverrinus*). So far as he is aware, this has not been previously done systematically, though isolated contributions have been made to the literature of the marsupial ovary.

This paper was originally submitted as a thesis for the degree of Doctor of Medicine of the University of Sydney, and the author begs to express his thanks to the Senate of the University for permission to publish the results of his investigation.

The collection of material and the obtaining of certain data made use of in this paper were done by Mr. J. P. Hill, D.Sc., F.L.S., Demonstrator of Biology in the University of Sydney, and well known as an authority on the processes of generation in the marsupial. To him the author tenders his sincere thanks for suggesting the undertaking of this research and for placing at his disposal a splendid series of ovaries in an excellent state of preservation.

The work was carried out during the year 1902 in the Anatomical Department of the University of Sydney, and to Professor J. T. Wilson, its head, the author tenders his best thanks for placing the resources of the Department at his disposal and for his kindly interest throughout the progress of this investigation; and he has also to thank Mr. Louis Schaefer, of the same Department, for aid in producing the micro-photographs which illustrate this paper.

SHORT REVIEW OF THE LITERATURE.

The literature of this subject is extensive, being scattered through periodicals, reviews, text-books and essays, and extends over three-quarters of a century of time, so that no exhaustive review of it can be undertaken, apart from the fact that many of the contributions in question are inaccessible in Australia. For a more extended criticism of different authors' views, and for an excellent bibliography up to the year 1895, the reader is referred to Sobotta's paper "Uber die Bildung des Corpus Luteum bei der Maus" in the Archiv für Mikroscopische Anatomie, Bd. 47, 1896, and to contributions mentioned therein; also to an article by the same author in Merkel and Bonnet's Ergebnisse, Bd. 8, 1898; and to J. G. Clark's article in the Archiv für Anatomie und Physiologie, 1898. It will be necessary to mention here only those points which enable the reader to follow the discussion.

In the year 1827 appeared a treatise by von Baer on the origin of the mammalian ovum. He described the ovum in the interior of the Graafian follicle, and recognised the fact of its escape by rupture. He described also the wall of the Graafian follicle, composed of membrana granulosa and theca folliculi, with its two component parts, the theca interna and theca externa. The main features of his description have been followed by all succeeding authors. He studied the corpus luteum, and attributed its origin to the inner layer or theca interna of the theca folliculi. He took this view on the grounds that the theca interna is thickened before the rupture of the follicle, and that this layer already possessed the characteristic yellow colour due to the so-called "lutein" granules. He is one of the few authors who studied the earlier developmental stages of the corpus luteum, and did not base his description on a study of corpora lutea near or during the stages of complete development.

No important communication was made upon this subject until 1840; when Patterson, of Edinburgh, brought forward a theory that the corpus luteum had its origin from the hæmorrhagic contents of the recently ruptured follicle. This theory gained the support of Henle, but was never generally accepted.

In 1842, Bischoff in his work "On the History of Development of Ova in the Rabbit" enunciated a new theory that the corpus luteum originated by modification of the cells of the membrana granulosa of the Graafian follicle to form the characteristic cells of the corpus luteum. A few years later, in ovaries of the dog, guinea pig and roe, he found confirmation of this theory. Bischoff studied all the stages of the formation of the corpus luteum both early and late, so that his work has a particular value. There are, therefore, excluding Patterson's, two different theories as to the origin and development of the corpus luteum. As time went on, defenders came forward for either theory. As adherents to von Baer's theory, we find Rokitansky, His, Spiegelberg, Kölliker, Slavjansky, Gegenbauer, Paladino, Nagel, Bonnet, Schottländer, Minot and others; whilst Pflüger, Luschka, Waldeyer, Call and Exner, and others have supported Bischoff's theory. Much of the work was not carried out upon a series of ovaries containing corpora lutea at all stages of development, so that it loses to a certain extent its value.

Up to the year 1895 it will not be necessary to further review the literature, except to state that Waldeyer held a view which was a compromise between the two theories. He considered that the epithelial element bore the greater part during the early development of the corpus luteum, but that, in the later stages, the theca folliculi had the greater share in its formation.

The year 1896 marks a distinct advance in the mode of study of this subject. Then there appeared from the pen of Sobotta a paper based upon an exhaustive study of the development of the corpus luteum in the mouse. All modern methods of studying this question must comply with the requirements that he has laid down. His most important contention is that the corpus luteum must be studied in all stages of its development, from its origin onwards, and not only in its stage of full development. In this research there have accordingly been chosen ovaries representing all the chief stages of corpus luteum formation, the stage of the development of the ovum and embryo being taken as a guide to the time which has elapsed since fertilisation of the ovum. This has the greatest advantages from a comparative point of view. Sobotta's paper appears to have awakened fresh interest in this question. He follows Bischoff's theory, and is supported by Heape, Stratz, Honore, Belloy, van der Stricht, Bonnet, Bouin, and van Beneden; whilst Nagel, Clark, Rabl, Kölliker, Doering, Paladino, Bühler and His have come forward as upholders of von Baer's theory. More extended criticism of these authors' views will be given when necessary in the following chapters.

MATERIAL AND METHODS.

Dasyurus viverrinus is a small marsupial, averaging when full-grown about the size and weight of a half-grown rabbit. Once a year it has a period of rut, during the months of May, June and July, and only then does the congress of the sexes take place. According to Hill, a varying period intervenes between coitus and the fertilisation of the ovum, so that the period of gestation is uncertain. It is probably about eight days. After gestation is completed, the embryo is transferred to the pouch. Six are usually found there at a time. They remain attached to the maternal teats for a period of seven or eight weeks, whilst the period of lactation is prolonged to about four months.

For the purposes of this investigation the sexes were allowed access to one another, and the date of coitus noted. The females were killed at a varying period afterwards. After securing the blood supply, the internal and external genitalia were removed and the stages of ovum or embryo corresponding were noted. The parts were placed in picro-sublimate solution for twenty-four hours and then transferred to alcohols.

Some were also treated with picro-nitric-aceto-osmic solution. Picro-sublimate fixing fluids were found very satisfactory.

The ovaries were transferred to absolute alcohol, cleared in cedar oil, afterwards put into benzol for 24 hours at a temperature of 45° C., to which melted paraffin at 40° C. to 45° C. was gradually added. Finally, the ovaries were transferred to paraffin with the melting point at 50° C., in which they were left at that temperature for a period of two to four hours. This method of embedding gave uniformly good results.

Sections were cut, some with Minot's microtome and some with the rocking microtome. Some were 6 micros. thick, but the majority 10 micros. They were mounted serially and stained according to requirements with Glychæmalum, Glychæmalum with Eosin, Iron-hæmatoxylin, and van Gieson's stain after Glychæmalum. This last was found particularly good for microphotographs, which were taken with Zeiss' apparatus.

This paragraph gives the particulars of the material employed. Other ovaries besides those mentioned below were cut, but these were considered to show the most representative stages of development of the corpus luteum. The stage of ovum or embryo is indicated in each case.

Ovary, Stage A.

Ripe follicles, some showing maturation spindle in the ovum.

Ovary, Stage B.

Taken immediately after rupture of the Graafian follicle, ova obtained from uterus before separation of the second polar body.

This Stage is referred to in this paper as the Polar-body Stage.

Ovary, Stage C.

Five days post coitum, ova in one- and two-cell stages.

Ovary, Stage D.

Ova in the sixteen- and thirty-two-cell stages, with unclosed blastodermic vesicles in some cases.

Ovary, Stage E.

Blastodermic vesicles, average diam. 1 mm.

Ovary, Stage F.

Blastodermic vesicles, average diam. 2·5 to 3 mm.

Ovary, Stage F_1.

Blastodermic vesicles, max. diam. 3·5 mm.

Ovary, Stage G.

Blastodermic vesicles, average diam. 3·5 to 4 mm.

Ovary, Stage H.

Blastodermic vesicles, average diam. 6·5 to 7 mm. Showing primitive streak and head process. Very large corpora lutea projecting on the surface of the ovary. This is about the stage of full development of the corpus luteum.

Ovary, Stage K.

Embryo 5·75 mm. long; late uterine stage, about the seventh day.

Ovary, Stage L.

New born young, three hours old, in pouch.

Ovary, Stage M.

Very small ovary, young animals 105 mm. long, head length 45 mm.

DEFINITION OF TERMS.

It will tend to avoid confusion if, before proceeding further, there be obtained a clear conception of what is meant by certain terms as used in this paper. All authors are not agreed as to the use of the terms "corpus luteum," "corpus luteum verum," "corpus luteum spurium vel falsum," and "corpus luteum atreticum." In this paper the term "*corpus luteum*" will be held to indicate the product of the changes which take place in the remaining structures of the Graafian follicle, after the extrusion and subsequent fertilisation of the ovum, that is, the "corpus luteum verum" of certain authors. Sobotta and others do not think that the fertilisation of the ovum is necessary, and maintain that the processes are the same, whether the ovum be fertilised or not. Waldeyer has lately insisted that the distinction must be given up, and it is probable that the process of corpus luteum formation in Dasyurus ovaries, whose ova are extruded, is the same whether fertilisation takes place or not. The term "*corpus luteum falsum*" or "*spurium*" will, however, for the present be applied as a term of convenience to those corpora lutea formed in ovaries whose ova are not fertilised. The term "*corpus luteum atreticum*" will here be taken to mean the corpus luteum which forms in an unruptured Graafian follicle —the "atresic follicle" to be described subsequently. Paladino has recently defined "true corpora lutea" as being those structures formed in ruptured follicles, and classified as "false" those formed in atresic follicles. Beigel is the only author who agrees with him. This is confusing, because the term "corpus luteum spurium" is often applied in man and animals to the corpus luteum which forms when pregnancy does not occur, although the ovum has been extruded. This variety of corpus luteum is distinct from the variety formed in atresic follicles. Playfair says that the difference between "true" and "false" corpora lutea in man is only in degree, whilst Dalton applied the term "false corpus luteum" to atresic corpora lutea sometimes found in human ovaries. In this paper the writer will adhere to the ordinary definitions, as explained above.

The term "corpus fibrosum" is used by various authors. It will be taken to mean the structure remaining after the degeneration of the corpus luteum, although Patenko extends this name to the connective tissue structure, which in some cases obliterates the atresic follicle.

THE PRIMORDIAL FOLLICLE.

Before entering upon the consideration of the primordial follicle itself, it will be necessary for the sake of completeness to describe shortly the appearance of the ovary macroscopically and microscopically. The organ in the period of its greatest size is of ovoid shape, measuring on an average 6 mm. by 5 mm. in its diameters. When the follicles are ripe they show as projecting bosses upon the surface. After their rupture the "stigma" can be seen, and soon also the corpus luteum, standing out as a yellowish-white structure against the general background of the ovary. In section, the organ shows the usual fibrous connective tissue stroma, containing ova in various stages of development. Near the periphery of the ovary, the fibrous tissue is condensed, and the surface of the organ is coated by a layer of cubical epithelium. A similar condensation of connective tissue is found round the larger primordial follicles and the more fully developed Graafian follicles. The smaller vessels are placed in these condensed areas of connective tissue, whilst centrally and elsewhere are found the larger vessels of the ovary, surrounded by a more rarefied stroma substance. Generally speaking, the young primordial ova lie in the peripheral condensed ovarian stroma, a little distance below the surface epithelium, and in the angles between the larger ova and follicles, where they approach the surface; whilst the older ova are not localised to any particular part of the ovary, many being superficial and many buried some distance beneath the surface (see fig. 2).

The ovum in its earliest recognizable stage (primordial ovum, see fig. 1) appears as a rounded cell placed in the condensed peripheral ovarian stroma, just beneath the epithelium of the surface. It is larger than the surrounding cells, and contains a finely granular cytoplasm which stains less deeply with hæmatoxylin than the neighbouring connective tissue elements. It is clearly distinguishable from the surrounding cells, and possesses a nucleus with a nucleolus, the nuclear chromatin being arranged peripherally near the nuclear membrane. At first there does not appear to be any trace of the future vitelline membrane or envelope of the ovum. In the cytoplasm of this primordial ovum, usually on opposite sides of the nucleus, are to be seen two dark bodies situated in a clear space, possibly the "centrosomes," which later on disappear. The cells of the ovarian stroma adjacent to the primordial ovum do not at first show any peculiarity, but soon cells make their appearance, which have a circular arrangement round the periphery of the ovic cell. These cells are flattened and epithelial in type, with a definite nucleus; their characters are shown in fig. 1. These cells soon become sharply marked off from the ovum by a membrane, the vitelline membrane. They are not at first marked off from the connective tissue stroma externally, but later on a membrane forms, which is the early representative of the "Glashaut," "basal membrane," or "membrana propria" of authors. The cells between the two membranes become more cubical in form, and are the first representatives of the cells of the membrana granulosa. At a very early stage, therefore, there are formed the rudiments of the more important structures of the ovarian ovum, with its surrounding cellular and membranous structures. The subsequent development of the ovic cell does not concern us further. Briefly, it increases in size, it forms yolk granules, the bodies like centrosomes disappear, and the nucleus becomes excentric or even peripheral.

After a certain stage, the ova grow very little, and the subsequent changes involve the membrana granulosa, which had attained the form of a single layer of cells, placed between two membranes. This single layer of cells multiplies to become a zone of cells, two, three, then nine to twelve cells in thickness, with nuclei showing many karyokinetic figures. The cytoplasm of the cells is lightly stained and the walls are indistinct, whilst the most externally placed cells (adjacent to the basal membrane) are regularly placed, and suggest an epithelial arrangement. The same applies in some cases to the cells near the vitelline membrane. At the angles between the cells are often to be observed spaces, probably to be accounted for by the rapid cell-growth not leaving time for the intercellular angles to be filled. These spaces are different from other spaces, walled in by cells arranged in an irregular way, due to the liquefaction of the cell cytoplasm after chromatolysis of the nuclei. Definite "corps vésiculeux," with cells radially arranged round them, as first described by Call and Exner in the rabbit—the "Epithelvacuolen" of Flemming—are not seen in Dasyurus, although in the larger primordial follicles and in the young Graafian follicles there are found spaces between irregularly arranged cells, showing in their interior an ill-defined system of trabeculæ. These are probably the representatives of the so-called "corps vésiculeux" of Call and Exner in Dasyurus. Similar structures are found in atresic follicles.

The characters of the theca folliculi will be described more fully later on, during the consideration of the ripe follicle. To the whole structure, as above described, consisting of ovum, membrana granulosa, and membranes with the theca folliculi, may be applied the term "primordial follicle."

THE GRAAFIAN FOLLICLE—ITS FORMATION AND RIPENING.

The development of the primordial follicle has been described in the preceding section. The next important event in its history is the formation of cavities in the membrana granulosa. This is brought about by liquefaction of the cell contents, following upon a chromatolysis of its nucleus, a process which can be observed to take place in several places at once, but progresses more rapidly in some places than in others. By the ultimate coalescence of these cavities the ovum is left in the centre of a vesicular structure, lined by cells of the membrana granulosa and connected to it by bands of cells, called "retinacula" (see fig. 4). This structure is called the "Graafian follicle." Its cavity contains fluid, formed probably by cell liquefaction and by secretion from them, and by the infiltration of lymph into the cavity. This formation of fluid goes on—evidently against pressure, other spaces appear in the membrana granulosa, the follicle increases greatly in size and becomes ripe.

THE RIPE GRAAFIAN FOLLICLE OF *DASYURUS VIVERRINUS*.

In determining what constitutes a ripe follicle in Dasyurus, one is guided by certain considerations.

Firstly, when the ovary of a non-pregnant female is examined macroscopically during the oestral period, the follicles which are ripe, or nearly so, are easily perceptible as prominent projections on the surface. They may be as many as twelve to fifteen in number. Microscopically, these projections are found to be due to large follicles which occupy the greater part of the section (see fig. 5), the larger vessels being placed centrally, and the stroma being diminished to a minimum, whilst in the angle between these large follicles are found young ova and follicles, some of which show signs of atrophy.

Secondly, from the microscopical characteristics of the ripe follicle, to be describedly presently, it is easy to tell whether it be ripe or nearly so. Sobotta says that the test of a ripe follicle is that the nucleus of the ovum must not be in the resting stage, but must either possess a maturation spindle or be preparing for its formation. This holds good also for Dasyurus.

A description of the ripe follicle necessitates the following subdivisions :—

1. Of the ovum.
2. Of the liquor folliculi.
3. Of the membrana granulosa.
4. Of the theca folliculi.

Firstly :—*The ovum* (see fig. 5) is ellipsoidal and surrounded by a thick envelope; its detailed description will be published later. It is surrounded by a "discus proligerus," and is placed usually towards the periphery of the follicle, and often near the site of the future rupture. The cells of the discus proligerus are of the same type as the cells of the membrana granulosa to be described presently, and the ovum with its discus is connected with the membrana granulosa by strings of similar cells—the "retinacula."

Secondly :—The liquor folliculi fills the follicle. In preserved ovaries it is represented by coagulum, staining fairly well with ordinary stains.

Thirdly :—The membrana granulosa forms the epithelial part of the follicular wall. It varies in thickness. At or about the stigmatic area it is thinned, and is only four or five, or even two or three layers of cells in thickness, whilst near the ovum it may be seven to ten layers of cells in thickness. The cells are small and compressed, with nuclei, some of which stain intensely with iron-hæmatoxylin, whilst others stain faintly. Mitotic figures are absent. Vacuoles are often present at the intercellular angles.

The membrana granulosa is bounded externally by the membrana propria (see fig. 6), which forms a basal membrane on which the cells of the membrana granulosa rest. This basal membrane is homogeneous, clear and refractile on section, and on its outer side lies the theca folliculi. It is present in most animals, swine being an exception. Its nature and origin are disputed ; probably it is an altered layer of the theca interna.

Fourthly :—The theca folliculi is, from the point of view of this paper, the most interesting of the structures surrounding the ovum. In all animals whose ovaries have hitherto been studied, the theca folliculi is described as being specialised into two layers, an outer fibrous layer called the "theca externa," and an inner "theca interna," whose cells are polygonal with rounded nuclei, and contain in their cytoplasm granules of the so-called "lutein" substance, and are separated from each other by a varying amount of fibrous material. In Dasyurus, this specialisation of the theca folliculi into theca externa and theca interna is extremely rudimentary. Indications of it are seen in the thecæ of primordial follicles (see figs. 6 and 7), in which there can be made out an outer theca externa of fibrous character, and an inner theca interna, with irregular flattened connective tissue cells, having oval nuclei with no karyokinetic figures, a granular cytoplasm, but no definite lutein granules, and no obvious intercellular substance. This layer contains the smallest blood vessels. As the follicle ripens, this differentiation becomes practically indistinguishable, the theca interna being represented by an indistinct layer of flattened nucleated cells, next the membrana propria, and resembling very closely the theca externa.

When the follicle is ripe, the stroma of the ovary generally is scanty; it is seen between adjacent ripe follicles as a thin layer of fibrous tissue, showing occasional nuclei, and contains larger blood vessels for the supply of the follicles. The stroma of the ovary is also very thin in the neighbourhood of the stigmatic area, where rupture will take place (see fig. 5). In Dasyurus, therefore, the theca folliculi has a rudimentary theca interna, which in the ripe follicle is reduced to a minimum, and never approaches the condition described in other animals.

THE RUPTURE OF THE FOLLICLE AND ITS CLOSURE.

When the follicle has become ripe it bursts, diminishes in size, and the position of its rupture can be seen on the surface of the ovary. The surface epithelium has broken away, and the fibrous wall opens to allow the extrusion of the ovum with discus proligerus and most of the liquor folliculi. The blood vessels of the thinned ovarian stroma throw out blood which in Dasyurus is found constantly upon the surface of the ovary. Intra-follicular hæmorrhage is very exceptional in this animal, and if it occurs is very slight, never more than a dozen red corpuscles being found in a ruptured follicle. The ova were found in the oviduct, some unsegmented, some giving off the polar body, some in the one- and two-celled stages. With the release of intra-follicular pressure the walls of the follicle tend to become approximated, corrugated and thickened, whilst at the site of rupture the two opposed surfaces of the membrana granulosa come together and adhere, so that there is formed a plug of epithelial cells (Bouchon épithélial), which closes the follicle (see figs. 8-9). This closure is an early event in Dasyurus, and takes place within the first few hours, before there is any attempt at formation of the corpus luteum.

Coincidently with these processes in the membrana granulosa, certain changes go on in the theca folliculi and the basal membrane. This latter is corrugated, but at first remains intact. The blood vessels of the theca dilate, either as a cause or an effect of the follicular rupture, and occupy the corrugations of the follicular epithelium and membrana propria. The blood supply increases, the cavity of the closed follicle shrinks, and the ovary begins the formation of its corpus luteum.

THE EARLY CORPUS LUTEUM.

In the consideration of the disputed question of the origin of the corpus luteum, the crucial period of time is when the constituent parts of the wall of the closed follicle undergo their transformation to form the component parts of the corpus luteum. It is, therefore, necessary to study these changes in detail. This description is founded upon the appearances of the early corpus luteum, at the Polar-body Stage of the ovum, and in the segmentation stages up to thirty-two cells, and the unclosed blastodermic vesicle, corresponding to Stages B, C and D previously indicated. The period of time occupied by the ovum in passing through these stages is not yet definitely known.

The three constituents of the follicular wall are affected in marked degree, and simultaneously. The event which can be considered to form the turning point in the transition of the follicle into the corpus luteum, is the rupture of the hitherto intact membrana propria. This is effected by the growth inwards of the theca folliculi, which bursts through the membrana propria and sends its connective tissue sprouts towards the cavity of the follicle. The membrana propria becomes indistinct near the apices of these sprouts and is lost. Elsewhere it persists, and for a comparatively long time can be seen as a homogeneous membrane sharply marking off the theca folliculi from the cells of the former membrana granulosa even after their transformation into the characteristic cells of the corpus luteum (see fig. 10).

The connective tissue of the theca folliculi plays a most important part in the formation of the early corpus luteum.

was seen previously that immediately after rupture of the follicle the blood vessels of the theca folliculi become enlarged at various points round the circumference of the follicle. At these points a sprouting of the connective tissue takes place. The cells enlarge, their nuclei increase in size, and some show karyokinetic figures. A new formation of blood vessels takes place at the same time, and these new blood vessels, with the connective tissue cells round them, wedge their way through the membrana propria and cells of the membrana granulosa toward the cavity of the follicle. This process goes on at the various points so that the whole early corpus luteum is represented by a lobulated structure (see fig. 11).

Next, the connective tissue bursts through the membrana granulosa completely, and reaches the cavity of the follicle, which it fills with loose connective tissue cells with processes which join, and form a connective tissue framework that fills the cavity of the ruptured follicle. In some cases, besides the connective tissue cells which are triangular in shape, there are found larger rounded cells with one or two nuclei, a granular protoplasm and a distinct wall. These often lie free in the cavity, singly or in masses, and many of them are seen in close proximity to bands of young fibrous tissue or between the ordinary connective tissue cells. They are probably "fibroblast" cells (see fig. 11).

The rate of metamorphosis of the cells of the membrana granulosa into those of the corpus luteum varies in its rapidity. Generally it does not begin until the connective tissue irrupts into the cavity of the follicle. In a few cases the cells of the membrana granulosa undergo their metamorphosis, and almost completely fill the cavity before tho connective tissue reaches it. At first the cells of the membrana granulosa, on being released from intrafollicular pressure, are crowded together by the collapse and corrugation of the follicular wall. The cells nearest the membrana propria and the irrupting blood vessels, are the first to show an alteration in character. Their cytoplasm swells and their nuclei become more regularly arranged than the nuclei placed more centrally. Many of them are oval in shape, and have the long axis of the nucleus radially placed. This swelling of the cytoplasm pushes the more centrally placed cells inwards, so that they encroach upon the central cavity with its connective tissue trabeculæ, and insinuate themselves between these trabeculæ. This cellular change is of the nature of an hypertrophy. No *multiplication of the cell nuclei by direct or indirect division can* be made out, though carefully and often searched for in sections treated with different stains.

To sum up, the early corpus luteum is formed from the ruptured follicle by two processes; first, an invasion of the cavity of the follicle by vascular connective tissue sprouts of the theca folliculi, it being impossible to distinguish between the part played by the theca externa and the rudimentary theca interna; and secondly, by an hypertrophy of the cells of the membrana granulosa.

THE LATER DEVELOPMENT OF THE CORPUS LUTEUM.

For the study of the later development of the corpus luteum, serial sections were made of ovaries corresponding to the stages of ovum and embryo represented by closed blastodermic vesicles up to the time of the formation of the primitive streak and head process of the early embryo, that is the Stages E, F, F_1, G and H, previously described. The last of these stages of the embryo is reached probably about the third day, though this point has not yet been accurately determined, and represents approximately the time when the formation of the corpus luteum is complete.

The formation of the corpus luteum is carried on along the lines already described. It has been shown how the connective tissue invades the cavity in the interior of the ruptured follicle. The chief feature of the connective tissue during the later development of the corpus luteum is the formation in connection with it of blood vessels, so that the interior of the young corpus luteum becomes filled with an angiomatous structure formed by branching blood vessels whose walls are composed of a single layer of flattened endothelial cells. These vessels exist under usual circumstances for some time previously to the filling of the spaces between them with corpus luteum cells. Whether they are formed by the connective tissue previously in the interior of the follicle, or by the sprouting of the blood vessels of the theca, is uncertain (see figs. 12, 13 and 14). These blood vessels are of the nature of venous sinuses, and no structures comparable to small arteries are found in the corpus luteum at any time.

Whilst the vessels are forming, the cells of the membrana granulosa undergo a peculiar change. This has been seen in its initial stages previously, but now becomes more marked. The cell cytoplasm swells, becomes filled with granules (even drops of secretion are described in some animals), the cell boundaries become distinct and the nuclei become oval with their long axis radial, whilst many of them have two distinct nucleoli. The nuclear chromatin becomes aggregated round the periphery of the nucleus, but karyokinetic figures are uniformly absent, though they have been searched for with great care. Some of the cells have two or even three nuclei, and the multiplication of the cells, if it takes place, is direct. Taken on the whole, the change in the membrana granulosa cell is probably a process of simple hypertrophy. The hypertrophying cells push inwards the other cells into the spaces between the blood vessels previously described, so that the cavity is encroached on and filled up. In most cases this filling up is completed at the Stage H, but a cavity filled with blood vessels and connective tissue may persist for a long time (see figs. 15 and 16).

The membrana propria loses its former distinctness. It is encroached upon by the cells of the theca nearest to it. The nuclei of the cells nearest the membrana propria increase in size, the membrana propria is dissolved, and the connective tissue cells invade the cells of the corpus luteum.

By the processes described it comes to pass that the emptied follicle is transformed into the corpus luteum. Briefly, these processes are the irruption of connective tissue into the cavity of the follicle and its subsequent vascularisation, accompanied by hypertrophy of the cells of the membrana granulosa. The corpus luteum forms quickly (within three days) and persists during the greater part of the time that the animal is lactating, ultimately disappearing when the young animal is capable of leading an independent existence.

In addition to these changes involving the conversion of the ruptured follicle into the corpus luteum, certain changes go on in the neighbouring ovarian structures. In a general view of the ovary in section, when the corpora lutea are formed it is found that the whole section is occupied by these structures (see fig. 17), whilst the general stroma of the ovary is reduced to a minimum. During the ripening of the follicle and during the process of corpus luteum formation the stroma becomes more and more rarefied and more fibrous, probably owing to the diverting of the blood supply to the nourishment of the follicle and the corpus luteum. This rarefaction is due to the disappearance of some of the connective tissue cells and the imbibition of fluid by the connective tissues generally. During its progress the larger vessels of the ovary and their branches between the corpora lutea become filled with blood; this congestion of the ovary during corpus luteum formation is a marked feature of the organ. This rarefaction persists whilst the corpora lutea are present in the ovary, and only with their disappearance does the ovarian stroma resume its ordinary condition.

The theca folliculi is affected in the same way. It undergoes changes in the later stages of corpus luteum formation. Its external part participates in the changes of the ovarian stroma, whilst its inner part (the rudimentary theca interna) has the size of its cellular nuclei increased, and is best preserved in the places where it is sending in its connective tissue processes towards the centre of the corpus luteum.

In addition to the development of the corpora lutea, and the changes in the stroma just described, other processes go on simultaneously in the ovary. If an ovary be examined at the time of ripening of the follicles or shortly after they burst, it will be found that it is crowded with young ova and follicles in various stages of development (see fig. 2). The smallest and youngest ova are found immediately below the surface, in the intervals between the follicles, whilst the larger are often found at some distance below the surface. With the formation of the corpora lutea, most of these ova and follicles undergo degeneration, which seems to affect them all except the youngest near the surface, and those which are nearing ripeness. The ova between and close to the corporea lutea are the first to go, and the effect of the growing corpus luteum seems to make itself felt in ever widening circles, so that finally, when the corporea lutea are fully formed, nearly all the residual ova are atrophied, with the exception of those young ova immediately below the surface. A few of the larger ova, further away from the influence of the corpus luteum, persist for a little while longer, but ultimately they atrophy and become of no account. This change is a progressive one, and quickly shows itself, so that when the corpus luteum has attained its full development the ova, with the exception of the smallest and most superficial, are in a state of atrophy (see fig. 17).

THE ATROPHY OF THE FOLLICLE, AND THE CORPUS LUTEUM ATRETICUM.

In this place it will be fitting to describe the characteristics of atrophic follicles and the so-called "corpora lutea atretica," that is, the corpora lutea formed in connection with certain follicles whose ova are not extruded.

With regard to the atrophic or atresic follicle, it is found that its fate is not the same in all cases. The difference depends on the size and development of the follicle before its atrophy begins, and upon the degree to which atrophic and other changes go on in its component parts.

The fate of the follicles near their ripeness will be described later. The remaining unripe follicles may be roughly classified into two varieties, large and small, whose characters have already been sufficiently described. In the larger follicles, up to about a stage represented by fig. 4, the atrophic follicles may be divided into those which ultimately come to have left one layer of cells of the membrana granulosa, and those which have more than one layer, two or three being a usual number. The atrophic process is similar in each case, and can be described as affecting, firstly, the contents of the follicles; secondly, the membrana granulosa; thirdly, the basal membrane; and fourthly, the theca folliculi.

The determination of the place where the atrophic changes begin is difficult. In Dasyurus the membrana granulosa is first affected. It will be seen that some of its nuclei stain deeply, and others only faintly. In these latter, chromatolysis takes place in the nuclei of those cells nearest the cavity of the follicle, the nuclear membrane disappears, and the chromatin becomes broken up into fine particles which are scattered through the general débris or aggregated into masses which stain deeply. Some of these deeply stained masses have been observed protruding from the cell nucleus, and in many cases seem to be nucleoli. In some cases also the formation of karyokinetic figures takes place in the nuclei of the cells of the degenerating membrana granulosa. This process has been fully described by Flemming and others, and is met with in atrophic follicles of many animals besides Dasyurus. Whilst this has being going on, the cell cytoplasm has undergone degenerative changes. In many animals a definite fatty degeneration has been described as taking place, but in Dasyurus this is not observed. The degeneration of cell substance appears to be a process of simple atrophy. It goes on until the membrana granulosa is reduced to a zone of cells inside the theca, often one or even two or three cells in thickness (see fig. 18).

The discus proligerus surrounding the ovum is not affected until comparatively late. Chromatolysis sets in, the cells atrophy in the usual way, and the envelope of the ovum crumples up, and is partially or totally destroyed, whilst its nucleus undergoes chromatolysis, and its cytoplasm loses its yolk granules and degenerates. By these processes the contents of the follicle come to be represented by a granular material which represents the liquor folliculi, together with débris of membrana granulosa cells and of the ovum. Through this granular material are scattered darkly stained granules, representing portions of the original chromatin of the various nuclei. Occasionally, too, cells are found, situated in a clear space in this granular content of the follicles. These are leucocytes, with the function of removing the granular débris; and there does not, in Dasyurus, appear to be any reason for thinking that these are membrana granulosa cells with a phagocytic action, such as has been attributed to them by some authors, *e.g.*, Schulin, Janosik, and Pflüger. Whilst the ovum is degenerating similar cells are sometimes found attacking it, but nowhere is there seen any sign of the transformation of membrana granulosa cells into a plasmodium, with the phagocytic action, as described by Matchinsky, though in small atrophic follicles there are sometimes found appearances similar to those figured by Matchinsky, which are but remnants of degenerated ova containing nucleated leucocytes (fig. 21).

The basal membrane is early affected. It disappears whilst the above described changes are going on. It is generally an early event, but may be late. The time of its disappearance varies, but whilst it is present there is no tendency for the innermost layer of the theca folliculi to encroach on the membrana granulosa (see figs. 19 and 20).

When the basal membrane disappears, the rudimentary theca interna folliculi encroaches on the membrana granulosa. It becomes thickened, its cells increase in size and project into the membrana granulosa, and even into the cavity of the follicle. With the atrophy of the remaining membrana granulosa cells, there is also multiplication of the cells of the theca interna, so that concentric layers of connective tissue cells are formed, tending to diminish the size of the follicular cavity. This process is aided by the ingrowth of connective tissue cells into the cavity, causing its ultimate obliteration.

In the second variety of these atrophic follicles, where there remains but one layer of cells of the membrana granulosa lining the cavity, the ordinary separation of the rudimentary theca interna from the membrana granulosa by the basal membrane, though present, is obscured, and there is no attempt at encroachment on the membrana granulosa by the theca folliculi, so that the atrophied follicle presents the appearance of a cyst, lined by a definite layer of more or less cubical epithelium, towards which the theca, at any rate for a time, may preserve its usual relations (see fig. 19). Occasionally, it appears that these cysts may remain for a considerable time, but the majority lose their layer of epithelium, and are obliterated by proliferation of the rudimentary theca interna and invasion of the cavity by connective tissue cells, as above described. It is probable that the two varieties of these larger atrophic follicles are due to variations of the same process, but the origin of the variation is obscure. The outer layer of the theca undergoes the changes which have been described previously in the consideration of the stroma of the ovary.

In the case of the smaller follicles, the process is less complicated, though similar. The vitelline membrane shrinks from the membrana granulosa cells, the ovum degenerates and is removed, whilst the membrana granulosa cells may persist as a single layer of cuboidal epithelium, or may atrophy, when the theca proliferates and fills up the cavity of the follicle. Occasionally, as in the case of other animals, a metaplasia of membrana granulosa cells into spindle- and star-shaped cells takes place. These fill up the space and cause its obliteration (see fig. 21).

In the case of follicles which are ripe or nearly so, whose ova are not extruded, there takes place a quite different process, which is not seen at all in the atrophy of the younger follicles. Practically, with the exception of the extrusion of the ovum, everything proceeds in the same way as if rupture had taken place. A corpus luteum atreticum is formed in the centre of which the atrophic ovum is seen, sometimes even making an attempt to segment (see figs. 22, 23, 24). The atrophied ovum is invaded by connective tissue and is removed by leucocytes. The membrana granulosa cells hypertrophy, the connective tissue of the theca grows in, in the same way as in the ordinary corpus luteum, and there is thus formed a corpus luteum atreticum.

It will be seen, therefore, that in Dasyurus there is no difference in the formation of the corpora lutea atretica, as compared with the mode of formation of the true corpus luteum. Some difference in size can sometimes be made out, the atresic being smaller than other corpora lutea, but, with this exception, the process is the same.

THE DECLINE OF THE CORPUS LUTEUM.

The growth of the corpus luteum in Dasyurus is rapid, and occupies the first three days after the follicular rupture. It remains in the same state for seven to eight weeks and then declines.

The chief factor in the decline of the corpus luteum is the supervention of a condition of fatty degeneration in its characteristic cells. The degenerated cells are removed by leucocytes, the blood vessels atrophy, and the connective tissue increases to form a corpus fibrosum, so that by the time the young animal is about ten centimètres long, some four months after its birth, there remains no trace of the corpus luteum in the ovary, which is found to be full of young ova beginning to grow in preparation for the next oestral period.

THE CORPUS LUTEUM OF *DASYURUS VIVERRINUS.*

In the short review of the literature given previously, the two main theories of origin of the corpus luteum were set forth. Some attribute its origin to the theca interna folliculi, others to the membrana granulosa. These divergent views have been taken by different authors for different animals, and in some cases the accounts differ for the same animal. It is worthy of note that those authors who have studied series of ovaries, sufficient to provide all the early stages of corpus luteum formation, are practically unanimous in contending that the characteristic cells *of the corpus luteum take origin from the cells of the membrana* granulosa. One of the best known of these is Sobotta, who, in the mouse and rabbit, carried out an exhaustive research on this question, and was the first to lay down the lines along which work to solve this question must be carried out. He is supported by Stratz, who in a lengthy article, including amongst others matters the history of the corpus luteum, gave a similar account of its origin founded on a complete study of numerous ovaries of *Tupaja* *javanica*, *Sorex vulgaris*, and *Tarsius spectrum*. Honore, too, in the rabbit, working in the same way, arrived at the same general conclusions as Sobotta and Stratz; and van der Stricht, working on ovaries of *Vespertilio murinus*, *V. pipistrellus*, *Plecotus auritus*, and *Vesperugo noctula*, from which an abundance of material was obtained, confirms Bischoff's theory. Van Beneden in the rabbit, Belloy in the guinea pig and rat, Heape in the monkey, Bouin in the rat and guinea pig, Bonnet in the dog, and Cornil and Kreis in man, have all arrived at a similar conclusion, though differing in minor points. Of these authors, Sobotta, van der Stricht, Honore and Stratz may be taken as examples of those who have founded their support of Bischoff's theory on the study of a sufficient series of ovaries to give them all the stages of corpus luteum formation, particularly the early ones. On the other hand, it is found that the upholders of von Baer's theory, famous anatomists though some of them be, have studied this question in an imperfect way. His, Kölliker, Rabl, Nagel, Paladino, Clark, Doering, and Bühler have lately come forward as opponents of Bischoff's theory. With the exception of Bühler, whose work is not yet complete, none of them have carried out a study of the corpus luteum in all its stages of development, or at any rate there is no record of their having done so. Therefore their statements do not bear so much weight as they otherwise would. It is only fair to state that, with regard to His and Kölliker, their more recent remarks on this subject were made in short discussions at Anatomical Congresses. Rabl admits that his material is not sufficient to be of great service in settling this question, whilst Nagel's opinion is expressed but shortly in von Bardeleden's "Anatomie." Paladino's recent contribution to this question is founded on old observations made without respect to more recent requirements. In the case of Doering and Clark, they have collected swine ovaries (in large numbers, it is true), but without reference to any data as regards oestrum, time of coitus, and stage of pregnancy; or if any, so that they have no certain knowledge of the actual stages of corpus luteum they have described.

Next, it is interesting to note that the discrepancy of authors' views depends to some extent on the size of the animal studied. His, for instance, said at Kiel in 1898, that in man and in larger mammals, the formation of corpora lutea from the theca interna was absolutely indisputable. Bühler, too, at Pavia in 1900, said that it was certainly not an accidental circumstance that the accounts of the origin of the corpus luteum should be so diametrically opposed in the smaller as compared with the larger mammals. Sobotta (Tübingen, 1899) denies that the size of the animal has anything to do with the question, and upon the grounds of comparative anatomy there would appear to be no reason why the origin of such a constantly occurring structure as the corpus luteum should be so radically altered. If it is so, in what animals of the mammalian order does the transition in mode of formation take place, or where do the transitional forms of corpus luteum appear? One is justified in supposing that the mode of formation of the corpus luteum is uniform throughout the mammalian order, though it may be obscured by accidental circumstances, so that, what holds good in Dasyurus—a marsupial—would probably hold good in the rabbit, mouse and guinea pig, and probably also in larger animals, as man and the swine.

But what are these accidental circumstances? It has been pointed out by various authors that the theca folliculi of most animals is composed of an outer fibrous theca externa and an inner theca interna, whose cells are more or less polygonal and filled with granules of the so-called "lutein" substance, and have between them a certain amount of intercellular fibrous tissue. There is in fact a definite specialisation of the theca folliculi into two layers. Now, many authors attribute the origin of the characteristic cells of the corpus luteum to the specialised theca interna, some on altogether insufficient grounds. Thus His (at Kiel, 1898) says that the structure of the theca interna folliculi is identical with that of the young corpus luteum. Nagel uses the same argument, but that is no proof that one originates from the other. His also says that the transition from one to the other can be traced step by step. Does he refer to one corpus luteum, or to the tracing of the transition through a series of ovaries containing corpora lutea in all stages of development? In Dasyurus, as shown previously, the specialisation of the theca folliculi is rudimentary; in other words, the accidental specialisation of the theca folliculi seems to be practically omitted, possibly owing to the lowly position of the animal in the mammalian order. There is accordingly no similarity between the cells of the rudimentary theca interna and the cells of the membrana granulosa or corpus luteum in Dasyurus, and consequently there is no mistaking the parts these two structures play in forming the corpus luteum. In tracing the transition, of which His speaks, in fully formed corporea lutea of Dasyurus, a certain apparent resemblance is at times to be seen between some of the theca interna cells and the cells of the corpus luteum. A superficial observer might view some of the cells as showing a transition of the theca interna cells into the cells of the corpus luteum, but if the growth of that structure is traced through its various stages it is found that the rudimentary theca interna plays no part in the formation of the characteristic cells of the corpus luteum, but limits itself entirely to the giving off of vascular connective tissue sprouts to the interior of the follicle. And this is what is to be expected, for the theca folliculi, from the time of formation of the primordial follicle up to the rupture of the follicle, merely plays the part of a stratum of tissue whose function is to provide blood supply and support to the contents of the follicle.. And indeed, the function of the theca folliculi seems to have been neglected in this connection by the majority of authors. In most animals there is described a thickening of the theca interna, with lutein granules in its cells during ripening of the follicle, which has been considered by some as a process of preparation for the formation of the corpus luteum by that layer. In Dasyurus, on the contrary, there are no cells containing lutein granules, and during the ripening of the follicle there is a progressive diminution of the rudimentary theca interna and a rarefaction of the theca generally, so that it is extremely unlikely that the sudden rupture of the follicle should bring about such a change in the hitherto passive theca folliculi as to enable it to form a large parenchymatous cellular structure like the corpus luteum.

But, apart from these general arguments, a solution of the question for Dasyurus will be found on observation of the actual processes of corpus luteum formation in that animal, and perhaps the most important point in time is that, just after the rupture of the follicle takes place, when the process of corpus luteum formation is carried on with great rapidity, particularly in small animals. On this account, Bühler says that Sobotta has not observed in the rabbit and mouse the first alteration of these folliculi, in which sprouting of the thecal tissue into the cavity of the corpus luteum takes place; and he says also that an observer who is unaware of the existence of these sprouts or cones of thecal tissue might regard them as parts of the epithelial layer. This criticism is entirely erroneous, for in both the cases of the rabbit and mouse, under the sections dealing with the freshly ruptured follicle and early corpus luteum, Sobotta has described, though perhaps not fully, these cones of thecal tissue sprouting from the theca interna. Certainly in his figures this point might have been made more clear, but there is no doubt that he has both recognised and described them. To resume, in Dasyurus, owing to the comparative simplicity of the theca folliculi, it is easy to follow its future development. At first it does not transgress the membrana propria, but soon ruptures it and wedges its way towards the cavity of the corpus luteum, and even at this time before it reaches the cavity it can be seen in many cases that the changes in the cells of the membrana granulosa are well marked, whilst between the sprouts are seen the membrana granulosa cells still sharply separated from the theca by the basal membrane. In some instances, too, the cavity of the follicle is almost filled with the hypertrophied cells of the membrana granulosa, even before the vascular connective tissue sprouts from the theca have time to gain the cavity of the follicle. The rate of alteration in the membrana granulosa cells and in the theca folliculi is not absolutely constant, but varies within limits, so that at given stages of the segmenting ovum there may in one case be found the corpus luteum a little further advanced than in another.

The amount of central tissue in the fully formed corpus luteum varies. Sometimes its interstices are completely filled with cells of the corpus luteum; at other times there persists for some time a cavity in the centre whose only content is connective tissue with occasional blood vessels.

In the preceding part of this section the chief points in connection with the theca folliculi have been shortly discussed. There are, however, in the case of the membrana granulosa other points concerning which authors are at variance.

In Dasyurus the membrana granulosa, unlike the theca folliculi, is throughout its existence characterised by active change. This is early evidenced by the multiplication of its layers, by the occurrence of karyokinetic figures in the membranæ granulosæ of the primordial and Graafian follicles, and by the general characters of their epithelial cells. It would not, therefore, be surprising to find that, after the follicular rupture, the membrana granulosa should persist and play a part in the formation of the corpus luteum. Many authors deny that this is so. Nagel, for instance, says that—in man—the membrana granulosa disappears absolutely. Bühler, too, in his preliminary note says the same, though at present his proofs are not forthcoming; whilst Kreis and others maintain that in man the cells of the membrana granulosa multiply or hypertrophy to form the characteristic cells of the corpus luteum. There is, therefore, a difference between observers who have taken man as the basis of their observations. Clark and Doering also deny that the membrana granulosa forms the characteristic cells of the corpus luteum. Clark says that (in the swine) a few of his preparations showed some epithelium, others almost none; and from this he concludes that the membrana granulosa completely disappears at the time of, or soon after rupture of the follicle. This is all the notice that Clark deems necessary to give to the description of a process whose study is so important to thoroughly understand this question, and he does not show a single figure to illustrate it. The haphazard way in which Clark and Doering collected their material has already been commented upon; but apart from this, the words of Clark's description indicate clearly that he is describing the membrana granulosa of an atresic follicle. In Dasyurus the same wholesale disappearance of membrana granulosa is observed, but only in atresic follicles up to a certain stage of ripeness. Doering denies that his isolated human corpus luteum was an atresic one, but owing to the imperfection of his diagrams and the shortness of his description, it is impossible to contradict his somewhat categorical statements. Doering says, too, in the earlier part of his paper, that "in most cases" the membrana granulosa disappears. He omits to mention what becomes of it in the remainder. Kölliker has also lately expressed himself as of the opinion that Sobotta's explanation of the origin of the corpus luteum in the mouse and rabbit does not convince him. He does not mention any of his own researches on the formation of true corpora lutea in the mouse, but on the ground that, in his opinion, they are of the same nature as corpora lutea atretica, he defends von Baer's theory.

Against these opinions we must weigh those of such authors sa Sobotta, Stratz, Honore, and van der Stricht, who have recently studied the corpus luteum in all its developmental stages, and described it with great care. They and many others are unanimous in their support of Bischoff's theory. It is unnecessary to dilate further on their mode of work, but this alone, in contrast with the comparatively scanty observations made by the defenders of von Baer's theory, entitles their opinion to the greater weight.

Turning to the membrana granulosa of Dasyurus, immediately after follicular rupture there is no sign of degeneration or disappearance of the membrana granulosa, and there has been seen and depicted the actual hypertrophy in the cell substance. It has been observed to begin nearest the theca, in many cases, even before the connective tissue has reached the cavity of the follicle. It has also been observed that it is usually well marked before the membrana propria loses its distinctness, and it is constantly found close to the connective tissue ingrowths from the theca into the cavity of the rudiment of the corpus luteum, and near sources of good blood supply. Also, in the many hundred of sections of corpora lutea examined at all stages of their formation, there has not been seen in one single instance any sign of atrophy of the former cells of the membrana granulosa, no chromatolysis, no fatty degeneration nor other degenerative phenomenon. On the other hand, there is, as described previously, a vigorous and rapid hypertrophy of the membrana granulosa cells; and this, too, in an animal whose theca interna is absolutely unimportant, and limits itself to supplying vascular connective tissue to the corpus luteum.

Finally, though many authors agree as to the persistence of the membrana granulosa cells, there are differences of opinion as to their subsequent life-history, The disputed point is, whether the cells increase by a pure hypertrophy, or whether they actually multiply. Some authors describe karyokinetic figures as occurring rarely, or frequently, in the nuclei. These are :—van der Stricht in the bat; Belloy in the rat and the guinea pig; Stratz in Tupaja, Sorex and Tarsius; Bouin in the rat and guinea pig, and Kreis in man. On the other hand :—van Beneden in bats, Honore in the rabbit, and Sobotta in the mouse and rabbit, deny that there is any karyokinesis in the cell nuclei. In Dasyurus, after a prolonged search, there has been found no karyokinesis. The nucleus seems to participate with the cell in its hypertrophy. Sometimes to all appearances one cell has two or even three nuclei. Possibly amitotic division of cells may occur, but this has also been sought for and not found.

Lately, some authors have concerned themselves with the structure of the individual cells. Regaud and Policard maintain that, with special staining, there can be demonstrated in the cells of the corpus luteum of the hedgehog droplets of a substance which may be supposed to be a cellular secretion, and this observation fits in with Prenant's hypothesis of the glandular nature of the corpus luteum.

To sum up, in *Dasyurus viverrinus* the process of corpus luteum formation is plain. In this process there are two factors which go on side by side. These are—firstly, the hypertrophy of the membrana granulosa cells to form the characteristic cells of the corpus luteum; and secondly, the invasion of these masses of hypertrophying cells by a vascular connective tissue framework which supports and nourishes the whole structure.

THE FUNCTIONS OF THE CORPUS LUTEUM.

Up to the present time several different theories have been brought forward to explain the functions of the corpus luteum; and Minot says "Concerning the function of the corpus luteum we possess scarcely any knowledge."

Most of the theories have had a mechanical basis. The corpus luteum has been deemed to act as a "stop-gap" to fill the cavity of the ruptured follicle, and thus to restore the circulatory conditions which have been disturbed by a sudden release in the tension of the ovary.

Clark offers another explanation. He maintains that the corpus luteum has the function of giving blood vessels to a part, which in the ordinary course of events would become scar tissue, and thus the ovary is maintained in a soft and resilient condition, favouring the complete development of future follicles.

Ingenious as this theory is, it seems that it, or any mechanical theory must be insufficient, which neglects to take into account the vital processes of the characteristic cells of the corpus luteum themselves, particularly in their relations to the changes in the rest of the ovary, in the uterus and genital apparatus, and in the whole organism generally. Prenant, in a highly interesting paper, has brought forward a very attractive theory to explain the origin of the corpus luteum (which he attributes to the membrana granulosa). He points out that, in all animals examined, the corpus luteum is a structure whose morphological characters are those of a glandular apparatus without a duct, possessing presumably an internal secretion; and that the cells of the corpus luteum elaborate material in their interior as has recently been described by Regaud, Policard and others, and also that they do not show (except occasionally) mitotic figures, though on this last point authors disagree. The corpus luteum of Dasyurus comes into line with other corpora lutea in these respects, and, like them, resembles closely the liver in its histological features. Prenant considers the corpus luteum a gland, and he is of opinion that its hypothetical secretion plays an important part in the organism, such as we are accustomed to attribute to the supposed ovarian internal secretion. After attempting to explain the phenomenon of chlorosis by the lack of this possible internal secretion, he proceeds to argue that the purpose of the corpus luteum is probably also to prevent ovulation in the period between successive oestra, or during pregnancy. This latter theory is supported by Beard, Regaud and Policard; and in the case of Dasyurus can be supported on the following grounds:—On taking a general view of the ova and their intraovarian history in Dasyurus, it was observed that, in common with other animals, during the period between the oestra, and towards the end of lactation, the corpus luteum disappeared, and then the young ova began to grow in preparation for the next oestral period. Also, as soon as the corpus luteum is formed, it is found that the ova, hitherto in various active stages of development, begin to atrophy as described above. This atrophy begins in the neighbourhood of the young corpus luteum, and the process seems to affect the ova in ever widening circles. This atrophy may be due partly to mechanical pressure and partly to the internal secretion of the corpus luteum, if it has one. It is at any rate certain that, in Dasyurus during the time of development and persistence of the corpus luteum, atrophy of the larger remaining ova takes place, and ovulation remains at a standstill. Some of the remaining ova (exceptions to the rule) have at first sufficient energy to carry them on for a while, but ultimately the corpus luteum triumphs over them and they atrophy.

In this connection, Fraenkel and Cohn's experiments (see Anat. Anz. 1902, pp. 294-300) are of interest. Working on Born's theory, that the corpus luteum is a gland elaborating an internal secretion whose function was to prepare the uterus for the reception of the egg, and to give the impulse to the organismal changes accompanying pregnancy, they performed certain experiments, suggested by the following considerations:—

(1) That the ovum cannot itself produce the changes in the organism, for these begin even before the ovum reaches the uterus.

(2) In ectopic gestation the uterus undergoes the usual changes, although the ovum is in the tube.

(3) If the ovum reaches the uterus, its growth alone does not explain the great increase in size of the uterus, and there must be some other factor at work.

The corpus luteum was thought to be this factor, because it is a large structure whose function is not evident, and which is remarkably constant throughout the mammalian order. These observers then, as an additional reason, say that Aplacentalia, such as Monotremes and Marsupials, whose ova develop outside the uterus (sic) possess only a rudimentary corpus lutem, or none at all. This is erroneous. Both these classes of animals have a large corpus luteum, consequently this reason carries no weight.

By their experiments they claim to have shown that, in the rabbit, destruction of the corpora lutea prevented the ovum from being retained in the uterus, and that the presence of the corpus luteum has some influence on this retention. Their work is not concluded, but promises to throw some new light on the function of the corpus luteum.

Some may object that these arguments lose weight in the case of the false corpora lutea and the corpora lutea atretica. But a similar, though modified, explanation may be considered to hold good in these cases. The ovary, in the case of the false corpus luteum, does not concern itself with the fate of the ovum. The absence of fertilisation can be considered to be an accidental failure of Nature's intention. The corpus luteum forms in just the same way, and with the same effect of staying ovulation until it atrophies, and possibly with the intention of preparing the genitalia and the organism generally for the changes which would under ordinary circumstances ensue. With regard to the corpus luteum atreticum, the failure of extrusion of the ovum is an accidental departure from the normal, so that in the case of follicles which have attained a certain stage in their process of ripening, they possess sufficient energy to proceed with the formation of a corpus luteum atreticum, thus trying to carry out their function. And here it is interesting to observe that occasionally the ovum of the atresic follicle itself undergoes a kind of parthenogenetic division, which seems to be an attempt on its part to carry out its destiny.

To sum up, it may be stated as probable, firstly, that the corpus luteum is a glandular structure with an internal secretion; and secondly, that it influences the genital organs and the organism generally and prevents ovulation during pregnancy, and temporarily if pregnancy does not occur.

SUMMARY.

The chief conclusions arrived at in this investigation on the corpus luteum of *Dasyurus viverrinus* are:—

(1) The characteristic cells of the corpus luteum are formed by hypertrophy of the cells of the membrana granulosa.

(2) The theca interna folliculi is rudimentary and forms only the vascular connective tissue of the corpus luteum.

(3) The corpus luteum atreticum is formed in the same way as the corpus luteum verum.

(4) Other atresic follicles are reduced to fibrous tissue or remain cystic.

(5) The corpus luteum is probably a gland with an internal secretion of use in the organism. It has the function of stopping ovulation during pregnancy and at the oestral periods.

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EXPLANATION OF PLATES.

Plate vi.

Fig. 1.—Section of ovary (C) showing earliest stages of ovum (× 350).

Above and to the left is seen the surface epithelium of the ovary, and in the right hand corner below appears a portion of an early corpus luteum. Five young ova are seen in the ovarian stroma. Round them all, cells are arranged more or less regularly. These are the early representatives of the membrana granulosa. The two smallest ova show no vitelline membrane; the other three do. All the young ova show the granular character of the cytoplasm, two show nuclei, and one a definite nucleolus in the nucleus. Round the largest of the five ova, the membrana granulosa is seen to be two cells thick in the lower and left half, whilst above and to the right there appears a rudimentary basal membrane. The rudiments of a theca are also seen outside the lower half of the membrana granulosa of this largest ovum.

Fig. 2.—Section of ovary (C) showing stages subsequent to those shown in fig. 1 (× 75).

Ova of various sizes are shown, and the multiplication of the layers of the membrana granulosa is seen. Below in the right hand corner is a large ovum with yolk granules, and a thick vitelline membrane, outside which are the basal membrane and the theca folliculi. A similar ovum is seen in fig. 3.

Plate vii.

Fig. 3.—Section of a primordial follicle from ovary C just before the appearance of the cavity (× 180).

Shows the ovum, containing yolk granules, with a thick vitelline membrane, and the cells of the membrana granulosa external to the vitelline membrane. Externally to the membrana granulosa again is a very definite basal membrane, and outside that the theca folliculi. A portion of the same follicle is shown under higher magnification in fig. 7.

Fig. 4.—A Graafian follicle at an intermediate stage of development (× about 75).

The ovum is seen in the centre, surrounded by a layer of cells which are attached by retinacula to the membrana granulosa. The basal membrane and theca *folliculi can also be made out.*

Plate viii.

Fig. 5.—Section of ripe follicle from the ovary, Stage A (× about 40).

This follicle was ripe as indicated by the maturation spindle in its contained ovum. The ovum is seen as an ellipsoidal body placed in the follicle, close to the surface of the ovary, and bound to the membrana granulosa by retinacula of cells. It is surrounded by the discus proligerus. The cavity *of the follicle is partially filled with coagulum of the liquor folliculi.* The membrana granulosa is shown and the theca externally.

Fig. 6 shows under high power portion of walls of adjacent ripe follicles (× 350).

This figure and the next indicate well the characters of the theca folliculi. Above and below are the membranæ granulosæ of the ripe follicles, some of the nuclei being faintly and others darkly stained. Indications of "Epithelvacuolen" are seen in places. The membranæ granulosæ are set upon a distinct membrana propria or basal membrane. On the side of the basal membrane, away from the membranæ granulosæ, there are to be seen darkly stained nuclei of the cells of the theca interna, whose rudimentary character is well shown. The rest of the tissue between the membranæ propriæ is theca externa whose fibrous tissue characteristics are well shown. Two blood vessels, one filled with coagulum and the other with blood corpuscles, are seen in section, and between their overlapping ends is seen a small ovum.

Plate ix.

Fig. 7.—Portion of primordial follicle shown in fig. 3 (× 500).

This figure shows at the extreme top a portion of the ovum, and its vitelline membrane. Next comes the membrana granulosa, with its outer-most cells set upon a distinct membrana propria or basal membrane. Immediately outside (*i.e.*, below) the membrana propria is seen the theca folliculi, and this figure shows the most extreme specialisation of theca folliculi into theca interna and theca externa found in Dasyurus. Small blood vessels are seen in the theca, and the characters of the two parts of the theca are to be distinguished. The lower part of the figure is occupied by cells of the young corpus luteum. In one place is illustrated the tendency for the theca interna to send in a process of itself towards the central cavity of the corpus luteum (not shown in the figure but placed below). On either side of this process the basal membrane is still fairly distinct, and the metamorphosis of the cells of the former membrana granulosa into those of the corpus luteum is just commencing.

Fig. 8.—Portion of a section from ovary, Stage B (× 80).

This section was taken through a newly ruptured follicle, but the plane of section does not go through the site of rupture. It shows the corrugation of the membrana granulosa and the dilatation of the blood vessels of the theca, which are pushing portions of the membrana granulosa towards the cavity, in which some remnants of coagulum are left.

Plate x.

Fig. 9.—From same ovary, Stage B (× 80).

Shows the freshly ruptured follicle, which has been closed. The site of rupture is easily distinguishable and also the plug of cells closing the aperture (Bouchon Epithélial). The membrana granulosa is beginning to thicken. The blood vessels of the theca are seen to be dilated in several places, and in one portion of the follicular wall below and to the left between dilated blood vessels can be seen still the persistent membrana propria. The theca folliculi is seen best on the left hand side of the follicle.

Fig. 10.—Portion of the wall of an early corpus luteum from ovary, Stage B (× 350).

This figure shows a sprout of connective tissue projecting into the membrana granulosa. The membrana propria is still seen distinctly in one place. To its left are cells of the membrana granulosa, and to its right the tissues of the theca interna, containing blood vessels filled with red corpuscles.

Plate xi.

Fig. 11.—Section of ovary, Stage C (× 130).

This figure is extremely interesting. It shows the filling of the central cavity of the corpus luteum with connective tissue which is irrupting in several places, notably above and to the left.* Numbers of rounde dcells, probably "fibroblasts," are seen in the interior of the follicle, many of them free and others placed in juxtaposition to a strand of connective tissue, which stretches across the cavity of the young corpus luteum. The thickening of the former membrana granulosa by hypertrophy of its cells is beginning, and in places, especially on the left of the section, the former relation of theca, basal membrane, and membrana granulosa still persists. The lobulated character of the young corpus luteum is also very apparent.

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* The right side of the Plate is to be regarded as the top of the figure.

Plate xii.

Fig. 12.—From ovary, Stage D (× 40).

A slightly later stage of the corpus luteum. The cavity is practically filled with young connective tissue.

Fig. 13.—From ovary, Stage E (× 50).

Shows corpus luteum at later stage still. By this time the cells of the membrana have undergone part of their metamorphosis, and have extended further into the cavity. Blood vessels are also seen working their way in between the cells of the corpus luteum; the lower part of the cavity shows some blood vessels streaming in towards the centre of the cavity, whilst above are seen, in between the loosely arranged cells of the corpus luteum, larger venous sinuses filled with blood.

Plate xiii.

Fig. 14.—From ovary, Stage F (× 50).

Shows a slightly later stage than fig. 13. The centre of the corpus luteum is filled with connective tissue, and the blood vessels have also reached the centre. The corpus luteum cells have by this time assumed more definite characters, but have not yet filled the central cavity.

Fig. 15.—From ovary, Stage G (× 130).

Showing the characters of the cells of the corpus luteum. Running up the centre of the figure is a connective tissue ingrowth, and on each side cells of corpus luteum. Between many of the cells are seen intervals which are vascular spaces lined by endothelium.

Plate xiv.

Fig. 16 —From ovary, Stage H, showing characters of cells of fully formed corpus luteum (× 500).

Darkly stained nuclei of connective tissue are seen in various places; and in the centre of the figure an elongated vascular space, immediately against which on the left are placed the characteristic cells of the corpus luteum. The nuclei and nucleoli of individual cells are to be made out, and the cell boundaries are in some cases fairly distinct.

Plate xv.

Fig. 17.—Section of ovary, Stage H (low magnification). Five fully developed corpora lutea are shown. The ovarian stroma is scanty and

rarefied, and numbers of atrophic follicles are seen in various places. The dark lines in the corpora lutea themselves represent vascular spaces filled with blood, and darkly stained with hæmatoxylin. A few large blood vessels are also seen in the centre of the ovary.

Fig. 18.—An atresic follicle in an early stage of degeneration (× 80)

Note that the retinacula are dissolved, and that the interior of the follicle is partly filled with coagulum, containing small darkly stained granules. In the original specimen the basal membrane was still distinguishable outside the atrophic membrana granulosa.

Plate xvi.

Fig. 19 shows one large and two small atresic follicles (× 50).

The large follicle has the remnant of the ovum, with some of the coagulum of the liquor folliculi for its contents. The cells of the membrana granulosa are degenerating, and the basal membrane has disappeared. The two smaller atresic follicles show the ovum in the centre, and a single layer of epithelium, set upon a basal membrane, which is distinct in places.

Fig. 20.—An atresic follicle (× 130).

This figure shows the degenerated ovum and coagulum in the cavity of the follicle. It also shows the degenerating membrana granulosa indistinctly separated (in the upper half) from the theca folliculi. The rarefaction of the ovarian stroma is also well shown (below and to the right). The rest of the figure is occupied by corpora lutea.

Plate xvii.

Fig. 21 shows a number of atrophic follicles with portions of two young corpora lutea (× 130).

Above is seen the surface epithelium of the ovary. A little below are seen three atrophic follicles, the middle one being the most interesting. It shows centrally a lightly stained mass with darkly stained spots, the whole having the appearance of a plasmodium under the microscope. The mass represents the remnant of the ovum invaded by leucocytes. Immediately external to the mass is a zone of darkly stained cells, which under a high power are seen to be somewhat fusiform, and resemble cells of connective tissue. These were originally membrana granulosa cells which are probably undergoing a metaplasia, as described in the text. Outside this zone of darkly stained cells (seen best above) is a zone of cells which represents the theca folliculi. Portions of young corpora lutea are seen below, and three old atrophic follicles in the interval between.

Plate xviii.

Fig. 22 shows sections of three corpora lutea, two of which are "true," and one (the central) is a corpus luteum atreticum (× 50).

A similarity in the general arrangement of the cells in the three is noticeable. The central corpus luteum shows in the cavity an ovum whose envelope is crumpled. The membrana granulosa is beginning to hypertrophy, and encroaches on the central cavity, particularly on the right hand side.

Plate xix.

Fig. 23.—A "corpus luteum atreticum" at about the stage represented in fig. 13.

Note the degenerated ovum towards the centre of the structure. It is placed against the left wall of the largest vascular space. Other vascular spaces lined by endothelium are also well seen, as well as the general similarity between this figure and fig. 13.

Plate xx.

Fig. 24 represents a "corpus luteum atreticum." This figure should be compared with fig. 14. The similarity in the structure of the two is noteworthy.

In the centre of the field is seen the remnant of the atrophied ovum invaded by leucocytes. Round this the "corpus luteum atreticum" has formed, and is exactly similar to the "corpus luteum verum." This figure illustrates the general dilatation of the blood vessels round the corpus luteum, and also the thinning of the ovarian stroma generally, with portions of corpora lutea on either side of the corpus luteum atreticum.

BOTANY OF THE DARLING, NEW SOUTH WALES.

By Fred. Turner, F.L.S., F.R.H.S., etc.

Introduction.

The Darling River and its tributaries drain an immense area in New South Wales, and although I have botanised over a great portion of it, this paper only refers to the vegetation found between the parallels 29° to 33° South and the meridians 141° (the boundary of this State and South Australia) and 147° East. The configuration of this region consists for the most part of nearly level country with isolated hills and a few mountain ranges, none of which, however, attain great altitude. This section of the country may be described as consisting of immense, treeless plains separated here and there by large belts of timber, and considerable areas of open forest, mallee, and scrub country. Some of the plains are composed of black soil, others of red loam, and certain are of a sandy nature. These are the principal soils of the Darling country, but there are many of an intermediate character. Some of the hills and ranges are very stony and difficult to ascend.

Climate.

Temperature at Bourke.

Mean temperature	69·7°
Mean summer temperature	83·6°
Mean winter temperature	54·7°
Highest temperature (shade)	127·0°
Lowest temperature (shade)	28·0°

In the extreme north-west, at Milparinka for instance, the temperature will range a few degrees higher, but those referred to will give a good idea of the climate of the Darling country.

RAINFALL.

The mean annual rainfall at Wilcannia is 11½ inches, but it ranges from 9¾ inches in the extreme west to 19½ inches in the extreme east.

WATER.

The principal natural water of this region is the Darling River (the "Calla-watta" of the aborigines), its tributaries, and several lakes. In propitious seasons the billabongs and deep depressions generally contain large quantities of water. Artificial supplies of water are obtained from a number of Government and private artesian wells. In this direction much enterprise has been shown, and many wells have been sunk into the cretaceous beds and abundant supplies of water obtained.

THE FLORA.

The first time that I had the privilege of examining plants collected in the Darling country was in April, 1880, but a few years previously I had seen similar flora from the south-western portion of Queensland. Amongst a number of collections of western plants that have since passed through my hands, the following might be referred to:—In 1885, at the request of Dr. E. P. Ramsay, F.R.S.E., then Curator of the Australian Museum, I named that very fine collection of graminaceous plants made by the late Mr. K. H. Bennett in the neighbourhood of Ivanhoe and Mossgiel. That collection was forwarded to the Indian and Colonial Exposition in London. Some time after this I named, by request, a large collection of plants from the Wilcannia district for Mr. J. H. Maiden, F.L.S, then of the Technological Museum, now Government Botanist. At the request of Mr. H. C. L. Anderson, M.A., Principal Librarian, Public Library, Sydney, I named those beautiful paintings, executed by Mrs. Harriet Forde whilst on the Darling in 1865-6, of some of the notable plants of the interior. Those paintings are now in the Public Library. In 1888 I figured and described some of the economic plants of the Darling; and all the principal trees, shrubs, saltbushes and herbs of that region which produce edible foliage for stock are figured and described in my book on the indigenous "Forage Plants of Australia" (non grasses) published in 1891. The most valuable graminaceous plants of that part of the State are figured and described in my work on the "Grasses of New South Wales," 1890, and "Australian Grasses," 1895. In 1900, at the request of the President of the Royal Commission on Western Lands, I wrote a voluminous report on the economic value of the flora of the Darling and the best means of conserving it. This is embodied in the Commissioners' Report to the Parliament of New South Wales. Since I first examined plants collected in the Darling country I have made many botanical excursions thither, both in good and bad seasons, and almost every time have seen some plants in bloom that I had not previously observed in that condition. The vegetation is so dissimilar from that growing on the eastern side of the Dividing Range that it has always had a peculiar interest for me. Some writers have described the western flora as sombre-looking and monotonous; this observation to a certain extent is true, especially when the pine forests, mallee, and scrub country are viewed from the hills or mountain ranges; nevertheless it is on the whole most interesting to the botanist, and much of it of great economic value to the pastoralist. One of the most charming arboreal floral displays I ever saw in the interior of this country was west of the Darling River where an open forest of Coolibar trees (*Eucalyptus microtheca*, F.v.M.) was in full bloom. The somewhat pendulous smaller branches of these trees were so densely covered with flowers that with the slightest breeze some of the lower ones swept the ground. To obtain a good knowledge of the flora of this region it is necessary to see and examine it at all times of the year, and in favourable and unfavourable seasons. This I have done, and by way of illustration may mention the fact that on a comparatively small area between the Darling River and Wanaaring one morning in a good season I collected more than ninety distinct species of plants, and about eighteen months afterwards the same ground was almost destitute of herbage, although several trees and shrubs were blooming profusely.

Towards the end of the comparatively mild winters experienced in the far west the bright flowers of many *Cruciferous* plants are a conspicuous feature on many of the plains. Several species, such as *Cardamine tenuifolia*, Hook., *Blennodia cardaminoides*, F.v.M., *Thlaspi cochlearinum*, F.v.M., and *T. ochranthum*, F.v.M., have comparatively large flowers and are certainly worth garden culture. One of the most beautiful evergreen trees is the so-called "native orange," *Capparis mitchelli*, Lindl. I have seen this tree producing its curious showy flowers in the driest seasons, and then it never fails to attract the attention of the most unobservant person. This species and one of the dwarfer-growing capers, *Capparis lasiantha*, R.Br., produce edible fruits of pleasant taste and much appreciated by the blacks. *Pittosporum phillyrœoides*, DC., is a very graceful tree with pendulous branches, narrow, evergreen, long leaves and small, bell-shaped flowers which are usually produced in great profusion. I have grown and flowered it to perfection in the neighbourhood of Sydney. In dry situations in the coastal districts it succeeds admirably and is well worth planting in mixed shrubberies. *Malvaceous* plants are fairly well distributed, some species producing showy flowers of various colours. One of the most beautiful flowering plants of this family is the "native cotton," *Gossypium sturtii*, F.v.M., which I have seen successfully cultivated in a garden at Bourke. Amongst the ornamental, and from a pastoralist's point of view the most valuable, trees in the interior is *Sterculia diversifolia*, G. Don. Its leaves are readily eaten by stock, which thrive on them. The seeds, usually produced in great abundance, contain 1·8 per cent. of caffeine, and I have made a capital beverage after roasting, grinding and macerating the grounds in a similar way to coffee. *Nitraria schoberi*, Linn., of the "bean caper" family, is a most interesting shrub with rigid branches, succulent leaves, and somewhat oval-shaped fruits which are edible but have a peculiar flavour to those not accustomed to eat them. They are, however, esteemed by the aborigines. Included under *Rutaceæ* is the interesting flowering shrub *Eriostemon difformis*, A. Cunn., the "wilga" (*Geijera parviflora*, Lindl.) which is often, and I think rightly, described as the most graceful tree of the interior, and the "native cumquat," *Atalantia glauca*, Hook. Of *Owenia acidula*, F.v.M., the "Colane," there is a pretty legend told by the aborigines of the Bogan. On some of my travels I have frequently remarked how very rarely a young "Colane" was to be seen, notwithstanding the fact that the old trees produce quantities of fruit which when ripe fall off and sometimes lie thick upon the ground under the branches. The blacks say that "little fellow moth comes out of fruit, flies along the plain, lays egg in the ground, and up comes 'Colane.'" The fruit is certainly attacked by some insect and the germ probably destroyed in a number, for small, circular holes may be seen in the hard putamen of many of those that have lain on the ground for some time. The reason, however, that so few young trees are seen is probably because stock eat them before they have a chance to grow to any height. An allied tree, *Flindersia maculosa*, F.v.M., has a remarkably spotted trunk, hence its popular name "Leopard tree." Its leaves make good feed for stock, and from its trunk and larger branches exude quantities of an amber-coloured gum of a pleasant taste, but it is not collected as a commercial product. The *Leguminous* plants of this region are both numerous and interesting, and when in bloom show to great advantage. Amongst the plants producing the showiest flowers are "Sturt's desert pea" (*Clianthus dampieri*, A. Cunn.), and those known locally as "Darling pea" (*Swainsona* spp.). These beautiful flowering plants have long since attracted the attention of horticulturists, and may now be seen growing in many Australian gardens on the eastern side of the Dividing Range as well as in the plant houses of Europe and America. Two species of *Swainsona*, *S. greyana*, Lindl., and *S. galegifolia*, R.Br., are suspected poison plants, the latter species having a bad reputation amongst stockowners.*

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* See Fred. Turner's and F. B. Guthrie's description and analysis of this plant, Agri. Gaz. of N.S.W., Vol. iv., p. 84.

One of the most interesting and at the same time most useful fodder plants is the "Darling clover," *Trigonella suavissima*, Lindl. Sir Thomas Mitchell was the first to find this plant on the Darling and to recommend it for its agreeable perfume and its delicious flavour as a vegetable. Amongst the shrubby *Leguminosæ* the various species of *Cassia* bloom profusely at certain seasons of the year, and the same may be said of some of the dwarfer-growing kinds of *Acacia*. Many species of the latter genus grow into fine trees, and certain of them produce timber useful for industrial purposes, whilst the leaves of some furnish feed for stock during dry periods.

Over a great portion of this region the genus *Eucalyptus*, either in an arboreal or shrubby state, occurs in greater or less profusion. Some of the species yield valuable timber which is used for a variety of purposes where strength and durability are required. The "River" or "Red Gum," *Eucalyptus rostrata*, Sch., grows fairly plentifully on the margins of the watercourses and on land subjected to periodical inundation, where it frequently attains large dimensions. The courses of the Darling River and its tributaries can be defined miles away by this tree, which is always a very distinctive feature in the landscape. Under *Cucurbitaceæ* there is one indigenous species, *Cucumis trigonus*, Roxb., which is found in various districts, and an allied African plant, *Cucumis myriocarpus*, Naud., has become acclimatised and has spread very much during recent years, especially on the lighter soils. The Australian mistletoe is growing on many trees and shrubs; one of the most common species being *Loranthus pendulus*, Sieb., though four other kinds are to be seen growing in varying proportions. *Compositæ* are well represented, especially on the plains, where usually during the early summer months and often in the autumn after rainfall the country looks like one immense flower garden. The blooms include many shades of colour, from white and yellow to bronze or red; the first-named colours predominating. Their habit, too, is most variable; certain are amongst the most diminutive plants in the interior of Australia, whilst others assume a shrubby habit.

The greater number, however, are dwarf-growing plants. Such genera as *Helichrysum*, *Helipterum*, &c., which produce what are known as everlasting flowers, are very showy and in ordinary seasons grow to perfection. The flowers are much esteemed by settlers in the interior, who use them for house decoration. Several species of the genus *Calotis* are disliked by the sheep-owner on account of the "burr"-like fruiting heads which they produce. The pappus surmounting each achene is composed of barbed bristles or sharp spines which get matted in the fleece, and being most difficult to got out, to a certain extent cause a depreciation in the value of the wool from a commercial point of view. The introduced South American plant called "Bathurst burr" (*Xanthium spinosum*, Linn.) is another very troublesome weed to the sheep owner. It has not spread as much, however, as I thought it would a few years ago; still it is fairly abundant in many places. The snuff plants, *Myriogyne minuta*, Less., and *M. racemosa*, Hook., are common in certain seasons, and usually grow on land liable to periodical inundation. The late Rev. Dr. W. Woolls, F.L.S., published some interesting particulars about these plants a few years ago. *Goodenoviece* are more largely represented in the western flora than one would expect. Several species of *Goodenia* and allied genera are an interesting sight when in bloom. Under *Campanulaceæ* there are only three genera, but two pretty flowering species of *Isotoma* and the Australian "blue bell," *Wahlenbergia gracilis*, DC., when in flower arrest attention. *Pratia erecta*, Gaud., of this family is a suspected poison plant. The climbing plants are not very numerous as regards species, but frequently one meets with a single representative of the following genera: *Clematis*, *Jasminum*, *Parsonsia*, *Lyonsia*, *Pentratropis*, *Marsdenia*, and *Tecoma*. The first and last named of these produce the showiest flowers. A curious plant is *Sarcostemma australe*, R.Br. In Queensland it is said to be very poisonous to stock, and in West Australia it has the reputation of being a good forage plant. My description of it has been published by the Government of West Australia for the information of land owners of the western State. Quite a number of interesting *Borageworts* are found both on the high and low land. Amongst the species of *Solanum* recorded in the following pages several are suspected by pastoralists of poisoning or causing injury to stock. The native tobacco, *Nicotiana suaveolens*, Lehm., and the South American one, *Nicotiana glauca*, Grah., are suspected stock-poisoners. The latter has spread very much on the rich alluvial banks of rivers, billabongs and creeks during the last few years. The renowned Pituri, *Duboisia hopwoodii*, F.v.M., occurs sparingly here and there. I had the privilege of witnessing some very important experiments carried out by the late Dr. Joseph Bancroft, of Brisbane, with an extract made from the leaves and smaller branches of this shrub. For further particulars see Dr. Bancroft's pamphlet on Pituri. *Mimulus prostratus*, Benth., of this family often covers the ground near lagoons with its charming blue flowers and when seen from a distance has the appearance of water. Under *Myoporineæ* is included the genus *Eremophila*, the species of which are amongst the most interesting in the interior. Most of them are of shrubby habit, but a few attain the dimensions of small trees. *Eremophila mitchelli*, Benth., is frequently called sandalwood on account of its fragrant timber. Many of these species are worth the attention of horticulturists not only for their ornamental appearance but for their charming flowers, which are usually produced in great profusion. A few interesting *Labiates* are found in different places, and one of the sweet-smelling native mints, *Mentha australis*, R.Br., is common on land that is liable to periodical inundation.

The order *Chenopodiaceæ* includes all those plants popularly known as "saltbush," which are amongst the most valuable in Australia for feeding stock. From various causes these plants are gradually disappearing from the interior, much to the regret of pastoralists. There are eleven genera and fifty-eight species found in varying proportions over this region. Of these I have figured and described, as to their economic value, thirty-four, under the authority of the Government of New South Wales. Amongst the *Amarantaceæ* are several species of *Trichinium* which are worth garden culture, as the flowers of these plants are most interesting and they are easily grown. The segments of the perianth are densely hairy and the colours range from greenish-yellow to bright purple. Under *Polygonaceæ* there are only three genera in the interior, but one of the species, *Muhlenbeckia cunninghami*, F.v.M., commonly known as "Lignum scrub" or "Sturt's leafless bramble," is of interest owing to the fact that during recent adverse seasons stock have taken to eating its usually succulent branchlets. Similar remarks as regards representation apply to *Protaceæ*, and there is one species of *Grevillea* (*G. striata*, R.Br.) worthy of notice. This tree is popularly known as "beefwood," and its timber is of some economic value, while its long, narrow leaves furnish food for stock when pasture herbage is scarce. Of the six species of *Pimelea* recorded in this paper some are regarded with suspicion by stock owners. *Euphorbiaceæ* are fairly abundant in many parts of the far west, and several species are suspected poison plants. Amongst these is *Euphorbia drummondii*, Boiss., which has the reputation of poisoning more sheep than any other Australian plant. From numerous enquiries and from observation extending over a very long period it appears that when the plant is in fruit and wet with dew or rain and is eaten by sheep it causes most injury to the animals. Four species of *Casuarina* are found dotted here and there over this area. The timber they yield is of some commercial value, and the branchlets are largely fed to stock in adverse seasons. The "Quandong" or "native peach," *Fusanus acuminatus*, R.Br., of the *Santalaceæ*, is fairly abundant. In ordinary seasons this tree produces quantities of fruit, the succulent epicarp of which is often employed for preserves and the pitted endocarp for beads which are made into necklaces, whilst the kernel, which is edible and of a pleasant flavour, is of an oily nature and may prove of some economic value eventually. Although there are only two species of the *Conifer* family found in the interior, they occupy immense areas of both inferior and good country and have been gradually increasing during the last two decades. Where these trees are established on inferior country it certainly would be wise to judiciously thin them out, then those that are left would prove of considerable commercial value and in the near future might be classed as a valuable State asset.

Amongst the *Monocotyledoneæ* I have found only one orchid (*Cymbidium canaliculatum*, R.Br.) and that is an epiphytal species. It was of some slight food value to the aborigines who used to eat its pseudobulbs which contain a small amount of starch. The *Amaryllideæ* consist of one species of *Crinum* and two of *Calostemma*, which grow over fairly large areas usually of a sandy nature in different parts of the far west. When in bloom these plants make a magnificent display, which would quite astonish any botanist or horticulturist seeing it for the first time. I have successfully grown these plants in the neighbourhood of Sydney, and I can highly recommend them for more extensive cultivation. A few species of the lily family are found almost all over this area. Two of them, *Bulbine bulbosa*, Haw., and *B. semibarbata*, Haw., are suspected poison plants. *Juncus communis*, E. Mey., is spreading, particularly on the margins of the streams flowing from some of the artesian wells. The dissemination of this plant is probably due to water fowl unconsciously carrying the ripe seeds on their legs or webbed feet and depositing them far from the plants on which they were matured. *Cyperaceæ* are numerous in many parts, but *Gramineæ* are abundant, as there are thirty-nine genera and ninety-nine species besides varieties, as well as several introduced ones. Of the number indigenous to this region I have figured and described (as to their economic value) fifty-one, under the authority of the Government of New South Wales.

Acotyledoneæ, as far as vascular *Cryptogams* are concerned, and this Census does not take into account cellular *Cryptogams*, are poorly represented. I have only observed five species arranged under three natural orders. One of the most interesting of these plants is the "Nardoo," *Marsilea drummondii*, A.Br. A figure and full description of this plant appears in my book on the indigenous "Forage Plants of Australia" (non grasses).

This is the first Census of the *Phanerogamia* and vascular *Cryptogamia* of the Darling country, and I hope it will be found useful to those who desire to study the flora of that portion of New South Wales. Many plants not hitherto recorded from that region will be found in the following pages.

All the indigenous plants included in this Census that I did not know at sight I have worked out by the diagnosis given in Bentham's "Flora Australiensis," and I have followed the same classification and nomenclature as have been adopted in that classical reference work.

The plants marked with an asterisk are exotic, but some of them have become acclimatised in the Darling country.

The plants marked with a dagger have been figured and described, as to their economic value, by me.

Some of the most intrepid explorers in Australia have collected plants in the Darling country. Amongst them may be mentioned Sturt, Mitchell, Cunningham, McDowall Stuart, Mueller, Dallachy and Beckler, whose names will never be forgotten whilst the vegetation of Australia lasts.

Mrs. H. Forde and Mr. G. Suttor collected some interesting specimens of plants on the Lower Darling in 1865-6. These were named by the late Rev. Dr. W. Woolls, F.L.S., who wrote a chapter about them in his book entitled "A Contribution to the Flora of Australia."

Mrs. Forde's beautiful paintings of some of the plants of the Darling have already been referred to in this paper.

My thanks are due to a number of pastoralists and stockmen for forwarding me botanical specimens for identification during the last twenty years.

The accompanying table shows the percentage of the indigenous *Phanerogamia* and the vascular *Cryptogamia* of the Darling country compared with the similar flora of New South Wales.

NEW SOUTH WALES.		DARLING RIVER.		PER CENTAGE.	
Dicotyledoneæ.		*Dicotyledoneæ.*			
Genera ...	662	Genera ...	249	Genera ...	37·61
Species ...	2393	Species ...	615	Species ...	25·69
Monocotyledoneæ.		*Monocotyledoneæ.*			
Genera ...	212	Genera ...	61	Genera ...	28·77
Species ...	668	Species ...	140	Species ...	20·95
Acotyledoneæ.		*Acotyledoneæ.*			
Genera ...	40	Genera ...	4	Genera ...	10·00
Species ...	145	Species .	5	Species ...	3·44
Total Genera	914	Total Genera	314	Genera . .	34·35
Total Species	3206	Total Species	760	Species ...	23·70

Class I. DICOTYLEDONS, Ray.

Subclass I. POLYPETALÆ.

Series I. THALAMIFLORÆ.

RANUNCULACEÆ, B. de Juss.
Clematis microphylla, DC.
Ranunculus lappaceus, Sm.
rivularis, Banks et Sol.

DILLENIACEÆ, Salis.
Hibbertia stricta, R.Br.

PAPAVERACEÆ, Juss.
Papaver horridum, DC.
Argemone mexicana, Linn.†*

CRUCIFERÆ, B. de Juss.
Nasturtium palustre, DC.
Cardamine tenuifolia, Hook.
hirsuta, Linn.
Alyssum linifolium, Steph.
Sisymbrium officinale, Scop.*
Blennodia filifolia, Benth.†
trisecta, Benth.†

CRUCIFERÆ.

Blennodia nasturtioides, Benth.†
eremigera, Benth.
cardaminoides, F.v.M.
lasiocarpa, F.v.M.†
canescens, R.Br.
cunninghamii, Benth.
Stenopetalum velutinum, F.v.M.
lineare, R.Br.
Menkea australis, Lehm.
Capsella bursa-pastoris, Mœnch.†*
Senebiera didyma, Pers.*
Lepidium leptopetalum, F.v.M.
phlebopetalum, F.v.M.
monoplocoides, F.v.M.
papillosum, F.v.M.
Thlaspi cochlearinum, F.v.M.†
ochranthum, F.v.M.

CAPPARIDEÆ, Juss.

Capparis lasiantha, R.Br.
mitchelli, Lindl.
loranthifolia, Lindl.
Apophyllum anomalum, F.v.M.

VIOLARIEÆ, De Cand.

Viola betonicæfolia, Sm.

PITTOSPOREÆ, R.Br.

Pittosporum phillyrœoides, DC.†
Billardiera scandens, Sm.

POLYGALEÆ, Juss.

Comesperma scoparium, Steetz.
ericinum, DC.

FRANKENIACEÆ, St. Hil.

Frankenia pauciflora, DC.

CARYOPHYLLEÆ, Labill.

Stellaria glauca, With.

- CARYOPHYLLEÆ.
  - *Stellaria media*, Linn.*
  - *Spergularia rubra*, Pers.
  - *Polycarpæa synandra*, F.v.M.
- PORTULACEÆ, Juss.
  - *Portulaca oleracea*, Linn.†
    - *filifolia*, F.v.M.
  - *Calandrinia polyandra*, Benth.
    - *pusilla*, Lindl.
    - *volubilis*, Benth.
- ELATINEÆ, Cam.
  - *Bergia ammannioides*, Roth.
- HYPERICINEÆ, St. Hil.
  - *Hypericum gramineum*, Forst.
- MALVACEÆ, Juss.
  - *Lavatera plebeia*, Sims.†
  - *Malva rotundifolia*, Linn.*
    - *parviflora*, Linn.*
  - *Malvastrum spicatum*, A. Gray.†
  - *Sida corrugata*, Lindl.
    - *spenceriana*, F.v.M.
    - *argentea*, Bail.
    - *intricata*, F.v.M.
    - *virgata*, Hook.
    - *petrophila*, F.v.M.
    - *subspicata*, F.v.M.
  - *Abutilon leucopetalum*, F.v.M.
    - *mitchelli*, Benth.
    - *cryptopetalum*, F.v.M.
    - *otocarpum*, F.v.M.
    - *avicennæ*, Gærtn.
    - *oxycarpum*, F.v.M.
    - *frazeri*, Hook.
  - *Hibiscus trionum*, Linn.
    - *brachysiphonius*, F.v.M.

MALVACEÆ.

Hibiscus kirchauffianus, F.v.M.
  sturtii, Hook.
Gossypium sturtii, F.v.M.†

STERCULIACEÆ, Vent.

Sterculia diversifolia, G. Don.†
Rulingia rugosa, Steetz.
Lasiopetalum behrii, F.v.M.
  baueri, Steetz.

Series II. DISCIFLORÆ.

LINEÆ, De Cand.

Linum marginale, A. Cunn.

ZYGOPHYLLEÆ, R.Br.

Tribulus terrestris, Linn.†
  cistoides, Linn.
Nitraria schoberi, Linn.
Zygophyllum apiculatum, F.v.M.†
  glaucescens, F.v.M.†
  iodocarpum, F.v.M.†
  billardieri, DC.
  fruticulosum, DC.

GERANIACEÆ, Juss.

Geranium dissectum, Linn.†
Erodium cygnorum, Nees.†
  cicutarium, L' Hér.*
Oxalis corniculata, Linn.

RUTACEÆ, Juss.

Zieria obcordata, A. Cunn.
  furfuracea, R.Br.
Eriostemon linearis, A. Cunn.
  difformis, A. Cunn.
Phebalium obcordatum, A. Cunn.
  glandulosum, Hook.
Asterolasia mollis, Benth.
Geijera parviflora, Lindl.†
Atalantia glauca, Hook.

MELIACEÆ, Juss.

Owenia acidula, F.v.M.
Flindersia maculosa, F.v.M.†

OLACINEÆ, Mirb.

Olax stricta, R.Br.

CELASTRINEÆ, R.Br.

Celastrus cunninghamii, F.v.M.

STACKHOUSIEÆ, R.Br.

Stackhousia monogyna, Labill.
    muricata, Lindl.

RHAMNEÆ, Juss.

Ventilago viminalis, Hook.
Pomaderris racemosa, Hook.
Spyridium subochreatum, Reissek.
    eriocephalum, Fenzl.
Cryptandra amara, Sm.
    tomentosa, Lindl.
    propinqua, A. Cunn.
    buxifolia, Fenzl.

SAPINDACEÆ, Juss.

Atalaya hemiglauca, F.v.M.†
Heterodendron oleæfolium, Desf.†
Dodonæa attenuata, A. Cunn.†
    cuneata, Rudge.
    peduncularis, Lindl.
    lobulata, F.v.M.†
    boroniæfolia, G. Don.
    stenozyga, F.v.M.

Series III. CALYCIFLORÆ.

LEGUMINOSÆ, Juss.

Suborder I. PAPILIONACEÆ.

Isotropis wheeleri, F.v.M.
Daviesia acicularis, Sm.

PAPILIONACEÆ.

- *Pultenæa microphylla*, Sieb.
  - *styphelioides*, A. Cunn.
  - *foliolosa*, A. Cunn.
- *Bossiæa ensata*, Sieb.
  - *walkeri*, F.v.M.
- *Templetonia egena*, Benth.
  - *sulcata*, Benth.
- *Hovea longifolia*, R.Br.
- *Crotalaria mitchelli*, Benth.
  - *cunninghamii*, R.Br.
  - *dissitiflora*, Benth.
- *Medicago sativa*, Linn.*
  - *denticulata*, Willd.*
- *Trifolium procumbens*, Linn.*
- *Trigonella suavissima*, Lindl.†
- *Lotus corniculatus*, Linn.
  - *australis*, Andr.
- *Psoralea eriantha*, Benth.
  - *patens*, Lindl.
  - *cinerea*, Lindl.
  - *tenax*, Lindl.
- *Indigofera enneaphylla*, Linn.
  - *trita*, Linn. f.
  - *australis*, Willd.
  - *brevidens*, Benth.
- *Tephrosia rosea*, F.v.M.
- *Sesbania aculeata*, Pers.
- *Clianthus dampieri*, A. Cunn.†
- *Swainsona greyana*, Lindl.
  - *galegifolia*, R.Br.†
  - *phacoides*, Benth.†
  - *burkittii*, F.v.M.
  - *oligophylla*, F.v.M.
  - *campylantha*, F.v.M.
  - *procumbens*, F.v.M.†

PAPILIONACEÆ.

Swainsona phacifolia, F.v.M.
  oroboides, F.v.M.†
  lessertiifolia, DC
  microphylla, A. Gray.
  frazeri, Benth.
  laxa, R.Br.
Glycyrrhiza psoraleoides, Benth.
Desmodium brachypodum, A. Gray.
  varians, Endl.
Vicia sativa, Linn.*
Glycine falcata, Benth.
  tabacina, Benth.
  sericea, Benth.
  tomentosa, Benth.
Erythrina vespertilio, Benth.
Galactia tenuifolia, Willd.
Vigna lanceolata, Benth.
Rhynchosia minima, DC.

Suborder II. CÆSALPINIEÆ.

Cassia sophera, Linn., var. *schinifolia*.
  pleurocarpa, F.v.M.
  pruinosa, F.v.M.†
  circinata, Benth.†
  phyllodinea, R.Br.†
  eremophila, A. Cunn.†
  artemisioides, Gaud.†
  sturtii, R.Br.†
  desolata, F.v.M.
Petalostyles labicheoides, R.Br.
Bauhinia carronii, F.v.M.

Suborder III. MIMOSEÆ.

Neptunia gracilis, Benth.
Acacia continua, Benth.
  triptera, Benth.

MIMOSEÆ.

Acacia spinescens, Benth.
lanigera, A. Cunn.
colletioides, A. Cunn.
tetragonophylla, F.v.M.
rigens, A. Cunn.
juncifolia, Benth.
calamifolia, Sweet.
conferta, A. Cunn.
aspera, Lindl.
obliqua, A. Cunn.
undulifolia, A. Cunn
microcarpa, F.v.M.
verniciflua, A. Cunn.
sentis, F.v.M.†
neriifolia, A. Cunn.
notabilis, F.v.M.
hakeoides, A. Cunn.
salicina, Lindl.
decora, Reichb.
brachybotrya, Benth.
amblygona, A. Cunn.
homalophylla, A. Cunn.†
pendula, A. Cunn.†
oswaldi, F.v.M.
stenophylla, A. Cunn.
sclerophylla, Lindl.
ixiophylla, Benth.
harpophylla, F.v.M.
excelsa, Benth.
burkittii, F.v.M.
aneura, F.v.M.†
doratoxylon, A. Cunn.
polybotrya, Benth.
dealbata, Link.
cardiophylla, A. Cunn.

MIMOSEÆ.

Acacia farnesiana, Willd.

ROSACEÆ, Juss.

Acæna ovina, A. Cunn.†

CRASSULACEÆ, De Cand.

Tillæa verticillaris, DC.

HALORAGEÆ, R.Br.

Haloragis ceratophylla, Endl.
odontocarpa, F.v.M.
glauca, Lindl.
tetragyna, Hook.
Myriophyllum variæfolium, Hook.
verrucosum, Lindl.
Ceratophyllum demersum, Linn.

MYRTACEÆ, Juss.

Calythrix tetragona, Labill.
Micromyrtus microphylla, Benth.
Bæckea crassifolia, Lindl.
behrii, F.v.M.
Leptospermum lævigatum, F.v.M.
flavescens, Sm.
Callistemon brachyandrus, Lindl.
Melaleuca uncinata, R.Br.
hakeoides, F.v.M.
pustulata, Hook.
Angophora intermedia, DC.
Eucalyptus leucoxylon, F.v.M.
melliodora, A. Cunn.
gracilis, F.v.M.
paniculata, Sm.
populifolia, Hook.
ochrophloia, F.v.M.
behriana, F.v.M.
pendula, A. Cunn.
uncinata, Turcz.

MYRTACEÆ.

Eucalyptus albens, Miq.
  melanophloia, F.v.M.
  microtheca, F.v.M.
  dumosa, A. Cunn.
  incrassata, Labill.
  dealbata, A. Cunn.
  viminalis, Labill.
  rostrata, Schlecht.
  oleosa, F.v.M.
  terminalis, F.v.M.
Syncarpia leptopetala, F.v.M.

LYTHRARIEÆ, Juss.

Ammannia multiflora, Roxb.
Lythrum salicaria, Linn.
  hyssopifolium, Linn.

ONAGRARIEÆ, Juss.

Œnothera biennis, Linn.*
Epilobium junceum, Forst.
Jussiæa repens, Linn.

CUCURBITACEÆ, Juss.

Cucumis trigonus, Roxb.
  myriocarpus, Naud.*
Melothria muelleri, Benth.

FICOIDEÆ, Dill.

Mesembryanthemum pomeridianum, Linn.*
Tetragonia expansa, Murr.†
Aizoon quadrifidum, F.v.M.
Trianthema decandra, Linn.
  crystallina, Vahl.
Mollugo glinus, A. Rich.
  orygioides, F.v.M.
  cerviana, Ser.

UMBELLIFERÆ, Juss.

Hydrocotyle trachycarpa, F.v.M.

UMBELLIFERÆ.

- *Trachymene pilosa*, Sm.
  - *cyanopetala*, Benth.
  - *australis*, Benth.
  - *glaucifolia*, Benth.
  - *incisa*, Rudge.
- *Eryngium rostratum*, Cav.
- *Daucus brachiatus*, Sieb.†

Subclass II. MONOPETALÆ.

LORANTHACEÆ, Juss.

- *Loranthus linearifolius*, Hook.
  - *exocarpi*, Behr.
  - *linophyllus*, Fenzl.
  - *pendulus*, Sieb.
  - *quandang*, Lindl.

RUBIACEÆ, Juss.

- *Hedyotis tillæacea*, F.v.M.
- *Canthium latifolium*, F.v.M.
  - *oleifolium*, Hook.
- *Pomax umbellata*, Soland.
- *Asperula scoparia*, Hook. f.
  - *conferta*, Hook. f.
- *Galium geminifolium*, F.v.M.
  - *gaudichaudi*, DC.

COMPOSITÆ, Vaill.

- *Leuzea australis*, Gaud.
- *Centaurea solstitialis*, Linn.†*
- *Onopordon acanthium*, Linn.*
- *Olearia cydoniæfolia*, Benth.
  - *lepidophylla*, Benth.
  - *subspicata*, Benth.
  - *ramosissima*, Benth.
  - *pimeleoides*, Benth.
  - *conocephala*, F.v.M.
  - *magnifolia*, F.v.M.

COMPOSITÆ.

- *Olearia muelleri*, Benth.
  - *decurrens*, Benth.
  - *teretifolia*, F.v.M.
  - *tenuifolia*, Benth.
- *Vittadinia australis*, A. Rich.
- *Podocoma cuneifolia*, R.Br.
- *Minuria leptophylla*, DC.
  - *cunninghamii*, Benth.
  - *integerrima*, Benth.
  - *denticulata*, Benth.
- *Calotis cuneifolia*, R.Br.
  - *cymbacantha*, F.v.M.
  - *erinacea*, Steetz.
  - *scabiosifolia*, Sond.
  - *scapigera*, Hook.
  - *lappulacea*, Benth.
  - *microcephala*, Benth.
  - *plumulifera*, F.v.M.
  - *hispidula*, F.v.M.
- *Brachycome melanocarpa*, Sond.
  - *pachyptera*, Turcz.
  - *basaltica*, F.v.M.
  - *trachycarpa*, F.v.M.
  - *exilis*, Sond.
  - *scapiformis*, DC.
  - *ciliaris*, Less.
- *Monenteles sphacelatus*, Labill.
- *Pluchea eyrea*, F.v.M.
- *Epaltes cunninghami*, Benth.
  - *australis*, Less.
- *Xanthium spinosum*, Linn.*
- *Siegesbeckia orientalis*, Linn.
- *Eclipta platyglossa*, F.v.M.
- *Glossogyne tenuifolia*, Cass.
- *Flaveria australasica*, Hook.

COMPOSITÆ.

Cotula australis, Hook.
Myriogyne minuta, Less.
racemosa, Hook.
Elachanthus pusillus, F.v.M.
Isoetopsis graminifolia, Turcz.
Myriocephalus rhizocephalus, Benth.
stuartii, Benth.
Angianthus brachypappus, F.v.M.
pusillus, Benth.
strictus, Benth.
Gnephosis eriocarpa, Benth.
skirrophora, Benth.
cyathopappa, Benth.
Calocephalus citreus, Less.
platycephalus, Benth.
Gnaphalodes uliginosum, A. Gray.
Craspedia pleiocephala, F.v.M.
chrysantha, Benth.
Chthonocephalus pseudoevax, Steetz.
Cassinia lævis, R.Br.
arcuata, R.Br.
Eriochlamys behri, Sond. et Muell.
Rutidosis helichrysoides, DC.
Millotia tenuifolia, Cass.
greevesii, F.v.M.
Ixiolæna leptolepis, Benth.
tomentosa, Sond. et Muell.
Podolepis rutidochlamys, F.v.M.
acuminata, R.Br.
canescens, A. Cunn.
lessoni, Benth.
siemssenia, F.v.M.
Leptorhynchus pulchellus, F.v.M.
waitzia, Sond.
Helichrysum semifertile, F.v.M.

COMPOSITÆ
- *Helichrysum bracteatum*, Willd.
  - *glutinosum*, Hook.
  - *podolepideum*, F.v.M.
  - *apiculatum*, DC.
  - *semipapposum*, DC.
  - *dockeri*, F.v.M.
  - *diosmifolium*, Less.
  - *adnatum*, Benth.
  - *cunninghamii*, Benth.
- *Waitzia corymbosa*, Wendl.
- *Helipterum polygalifolium*, DC.
  - *floribundum*, DC.
  - *incanum*, DC.
  - *cotula*, DC.
  - *hyalospermum*, F.v.M.
  - *strictum*, Benth.
  - *corymbiflorum*, Schlecht.
  - *pygmæum*, Benth.
  - *moschatum*, Benth.
  - *dimorpholepis*, Benth.
- *Gnaphalium japonicum*, Thunb.
  - *indicum*, Linn.
- *Senecio gregori*, F.v.M.
  - *macranthus*, A. Rich.
  - *lautus*, Forst.
  - *behrianus*, Sond. et Muell.
  - *brachyglossus*, F.v.M.
  - *cunninghami*, DC.
- *Cryptostemma calendulaceum*, R. Br.†*
- *Picris hieracioides*, Linn.

STYLIDIEÆ, R. Br.
- *Stylidium eglandulosum*, F.v.M.

GOODENOVIEÆ, R. Br.
- *Velleia paradoxa*, R. Br.
- *Goodenia geniculata*, R. Br.

GOODENOVIEÆ.

Goodenia hederacea, Sm.
    calcarata, F.v.M.
    cycloptera, R.Br.
    pinnatifida, Schlecht.
    heteromera, F.v.M.
    glauca, F.v.M.
    gracilis, R.Br.
Scævola spinescens, R.Br.
    ovalifolia, R.Br.
Dampiera lanceolata, A. Cunn.

CAMPANULACEÆ, Juss.

Pratia erecta, Gaud.
Isotoma axillaris, Lindl.
    petræa, F.v.M.
Wahlenbergia gracilis, DC.

EPACRIDEÆ, R.Br.

Melichrus urceolatus, R.Br.

JASMINEÆ, Juss.

Jasminum lineare, R.Br.†

APOCYNEÆ, Juss.

Alstonia constricta, R.Br.
Parsonsia lanceolata, R.Br.
Lyonsia eucalyptifolia, F.v.M.

ASCLEPIADEÆ, R.Br.

Sarcostemma australe, R.Br.†
Pentratropis quinquepartita, Benth.
Marsdenia leichhardtiana, F.v.M.†

LOGANIACEÆ, R.Br.

Logania linifolia, Schlecht.
    nuda, F.v.M.

GENTIANEÆ, Juss.

Sebæa ovata, R.Br.
Erythræa australis, R.Br.†

BORAGINEÆ, Juss.
- *Heliotropium curassavicum*, Linn.
  - *europæum*, Linn.
  - *ovalifolium*, Forst.
- *Halgania strigosa*, Schlecht.
  - *lavandulacea*, Endl.
- *Trichodesma zeylanicum*, R.Br.
- *Echinospermum concavum*, F.v.M.
- *Rochelia maccoya*, F.v.M.
- *Cynoglossum suaveolens*, R.Br.

CONVOLVULACEÆ, Juss.
- *Ipomœa sepiaria*, Kœn.
- *Convolvulus erubescens*, Sims.
- *Polymeria longifolia*, Lindl.
- *Breweria media*, R.Br.
- *Cressa cretica*, Linn.
- *Evolvulus alsinoides*, Linn.
- *Wilsonia humilis*, R.Br.
  - *rotundifolia*, Hook.
  - *backhousii*, Hook. f.

SOLANEÆ, Juss.
- *Solanum nigrum*, Linn.†
  - *simile*, F.v.M.
  - *parvifolium*, R.Br.
  - *ferocissimum*, Lindl.
  - *esuriale*, Lindl.
  - *chenopodinum*, F.v.M.
  - *sturtianum*, F.v.M.
  - *petrophilum*, F.v.M.
  - *ellipticum*, R.Br.
- *Lycium australe*, F.v.M.
- *Nicotiana suaveolens*, Lehm.
  - *glauca*, Grah.†*

SCROPHULARINEÆ, Mirb.
- *Duboisia hopwoodii*, F.v.M.

SCROPHULARINEÆ.
Mimulus gracilis, R.Br.
repens, R.Br.
prostratus, Benth.
Morgania floribunda, Benth.
glabra, R.Br.
Peplidium humifusum, Delile.
Veronica peregrina, Linn.

BIGNONIACEÆ, R.Br.
Tecoma australis, R.Br.

ACANTHACEÆ, R.Br.
Ruellia australis, R.Br.
Justicia procumbens, Linn.

PEDALINEÆ, R.Br.
Josephinia eugeniæ, F.v.M.

MYOPORINEÆ, R.Br.
Myoporum acuminatum, R.Br.
deserti, A. Cunn.†
platycarpum, R.Br.
Pholidia dalyana, F.v.M.
scoparia, R.Br.
divaricata, F.v.M.
Eremophila bowmanni, F.v.M.
oppositifolia, R.Br.†
sturtii, R.Br.
mitchelli, Benth.
latrobei, F.v.M.
macdonellii, F.v.M.
longifolia, F.v.M.†
polyclada, F.v.M.
bignoniæflora, F.v.M.†
freelingii, F.v.M.
goodwinii, F.v.M.
brownii, F.v.M.
duttoni, F.v.M.

MYOPORINEÆ.
Eremophila maculata, F.v.M.†
latifolia, F.v.M.
alternifolia, R.Br.

VERBENACEÆ, Juss.
Verbena officinalis, Linn.
Spartothamnus junceus, A. Cunn.

LABIATÆ, Juss.
Mentha australis, R.Br.
Prostanthera nivea, A. Cunn.
striatiflora, F.v.M.
microphylla, A. Cunn.
aspalathoides, A. Cunn.
Westringia eremicola, A. Cunn.
Teucrium racemosum, R.Br.
Ajuga australis, R.Br.
Stachys arvensis, Linn.†*

PLANTAGINEÆ, Juss.
Plantago varia, R.Br.†

Subclass III. MONOCHLAMYDEÆ.

PHYTOLACCACEÆ, Endl.
Gyrostemon cyclotheca, Benth.
Codonocarpus cotinifolius, F.v.M.†

CHENOPODIACEÆ, Meisn.
Rhagodia parabolica, R.Br.†
gaudichaudiana, Moq.
spinescens, R.Br.
hastata, R.Br.†
nutans, R.Br.†
linifolia, R.Br.
Chenopodium nitrariacea, F.v.M.†
auricomum, Lindl.†
carinatum, R.Br.†
cristatum, F.v.M.

CHENOPODIACEÆ.

Chenopodium atriplicinum, F.v.M.†
Atriplex stipitata, Benth.†
  quinnii, F.v.M.
  nummularia, Lindl.†
  rhagodioides, F.v.M.†
  vesicaria, Hew.†
  velutinella, F.v.M.†
  angulata, Benth.†
  semibaccata, R.Br.†
  microcarpa, Benth.
  campanulata, Benth.†
  leptocarpa, F.v.M.†
  limbata, Benth.†
  halimoides, Lindl.†
  holocarpa, F.v.M.†
  spongiosa, F.v.M.
Enchylæna microphylla, Moq.
  tomentosa, R.Br.†
Kochia lobiflora, F.v.M.
  lanosa, Lindl.
  triptera, Benth.
  brevifolia, R.Br.†
  pyramidata, Benth.†
  eriantha, F.v.M.†
  villosa, Lindl.†
  planifolia, F.v.M.†
  sedifolia, F.v.M.†
  aphylla, R.Br.†
  ciliata, F.v.M.†
  brachyptera, F.v.M.†
  stelligera, F.v.M.†
Chenolea dallachyana, Benth.†
  tricornis, Benth.
  sclerolænoides, F.v.M.†
Babbagia dipterocarpa, F.v.M.

CHENOPODIACEÆ.
- *Sclerolæna diacantha*, Benth.†
  - *lanicuspis*, F.v.M.
  - *bicornis*, Lindl.
  - *biflora*, R.Br.
  - *paradoxa*, R.Br.†
- *Threlkeldia brevicuspis*, F.v.M.
- *Anisacantha muricata*, Moq.
  - *divaricata*, R.Br.
  - *bicuspis*, F.v.M.
  - *echinopsila*, F.v.M.
- *Salicornia robusta*, F.v.M.
  - *leiostachya*, Benth.
  - *tenuis*, Benth.
- *Salsola kali*, Linn.

AMARANTACEÆ, Juss.
- *Amarantus mitchellii*, Benth.
  - *macrocarpus*, Benth.
  - *tenuis*, Benth.
  - *enervis*, F.v.M.
- *Trichinium obovatum*, Gaud.†
  - *parviflorum*, Lindl.
  - *alopecuroideum*, Lindl.
  - *nobile*, Lindl.†
  - *macrocephalum*, R.Br.
  - *exaltatum*, Benth.
  - *semilanatum*, Lindl.
  - *erubescens*, Moq.†
- *Alternanthera nodiflora*, R.Br.

POLYGONACEÆ, Juss.
- *Rumex halophilus*, F.v.M.
- *Polygonum plebeium*, R.Br.
  - *lapathifolium*, Linn.
  - *attenuatum*, R.Br.
- *Muhlenbeckia polygonoides*, F.v.M.
  - *cunninghamii*, F.v.M.

NYCTAGINEÆ, Juss.
  Boerhaavia diffusa, Linn.†
PROTEACEÆ, Juss.
  Isopogon petiolaris, A. Cunn
  Grevillea pterosperma, F.v.M.
    huegellii, Meisn.
    striata, R.Br.
    triternata, R.Br.
  Hakea purpurea, Hook.
    leucoptera, R.Br.†
THYMELEÆ, Juss.
  Pimelea colorans, A. Cunn.
    spathulata, Labill.
    collina, R.Br.
    sericostachya, F.v.M.
    microcephala, R.Br.
    flava, R.Br.
    curviflora, R.Br., var.
EUPHORBIACEÆ, Juss.
  Euphorbia australis, Boiss.
    drummondii, Boiss.
    eremophila, A. Cunn.
  Beyeria viscosa, Miq.
  Ricinocarpus bowmanni, F.v.M.
  Bertya cunninghami, Planch.
    mitchelli, Muell.
  Phyllanthus rigens, Muell.
    ramosissimus, Muell.
    lacunarius, F.v.M.
  Adriana acerifolia, Hook.
  Ricinus communis, Willd.†*
CASUARINEÆ, Mirb.
  Casuarina stricta, Ait.
    glauca, Sieb.†
    cunninghamiana, Miq.
    distyla, Vent.

SANTALACEÆ, R. Br.

Santalum lanceolatum, R. Br., var. *angustifolium*.
Fusanus acuminatus, R. Br.†
Exocarpus spartea, R. Br.
  aphylla, R. Br.
  stricta, R. Br.

Subclass IV. GYMNOSPERMÆ.

CONIFERÆ, Juss.

Frenela robusta, A. Cunn.
  endlicheri, Parlat.

Class II. MONOCOTYLEDONS, Ray.

HYDROCHARIDEÆ, Lam.

Ottelia ovalifolia, L. C. Rich.
Hydrilla verticillata, Casp.

ORCHIDEÆ, R. Br.

Cymbidium canaliculatum, R. Br.

AMARYLLIDEÆ, St. Hil.

Crinum flaccidum, Herb.
Calostemma purpureum, R. Br.
  luteum, Sims.

LILIACEÆ, De Cand.

Bulbine bulbosa, Haw.
  semibarbata, Haw.
Thysanotus baueri, R. Br.
Corynotheca lateriflora, F. v. M.
Tricoryne elatior, R. Br.

COMMELYNACEÆ, Endl.

Commelyna ensifolia, R. Br.

JUNCACEÆ, Agardh.

Xerotes longifolia, R. Br.
  filiformis, R. Br.
  leucocephala, R. Br.
Luzula campestris, DC.
Juncus communis, E. Mey.

NAIADEÆ, Agardh.
- *Potamogeton natans*, Linn.
  - *crispus*, Linn.

CYPERACEÆ, R.Br.
- *Cyperus pygmæus*, Rottb.
  - *gracilis*, R.Br., var.
  - *squarrosus*, Linn.
  - *difformis*, Linn.
  - *concinnus*, R.Br.
  - *vaginatus*, R.Br.
  - *gilesii*, Benth.
  - *fulvus*, R.Br.
  - *iria*, Linn.
  - *diphyllus*, Retz.
  - *rotundus*, Linn.†
  - *subulatus*, R.Br.
  - *exaltatus*, Retz.
- *Heleocharis acuta*, R.Br.
- *Fimbristylis velata*, R.Br.
  - *neilsoni*, F.v.M.
  - *barbata*, Benth.
- *Scirpus setaceus*, Linn.
- *Schœnus turbinatus*, Benth.
  - *aphyllus*, Bœck.
  - *melanostachyus*, R.Br.
- *Carex gunniana*, Boott.

GRAMINEÆ, R Br.
- *Eriochloa punctata*, Hamilt.†
- *Panicum cœnicolum*, F.v.M.†
  - *divaricatissimum*, R.Br., et vars.†
  - *macractinium*, Benth.†
  - *leucophæum*, H. B. et K., et vars.†
  - *flavidum*, Retz., et var.†
  - *gracile*, R.Br.†
  - *helopus*, Trin.
  - *gilesii*, Benth.

GRAMINEÆ.

Panicum distachyum, Linn.†
  reversum, F.v.M.
  colonum, Linn.
  crus-galli, Linn.†
  adspersum, Trin.
  miliaceum, Linn.*
  effusum, R.Br., et var.†
  mitchelli, Benth.
  decompositum, R.Br.†
  trachyrhachis, Benth.
  prolutum, F.v.M.†
Setaria glauca, Beauv.†
  viridis, Beauv.*
Plagiosetum refractum, Benth.
Chamæraphis spinescens, Poir.
Spinifex paradoxus, Benth.
Lappago racemosa, Willd.
Neurachne alopecuroides, R.Br.
  mitchelliana, Nees.†
  munroi, F.v.M.
Perotis rara, R.Br.
Pollinia fulva, Benth.†
Andropogon erianthoides, F.v.M.†
  sericeus, R.Br.†
  exaltatus, R.Br.
  bombycinus, R.Br.†
Chrysopogon gryllus, Trin.
Sorghum halepense, Pers.
Anthistiria ciliata, Linn.†
  avenacea, F.v.M.†
  membranacea, Lindl.†
Alopecurus geniculatus, Linn.†
Phalaris canariensis, Linn.*
Aristida stipoides, R.Br.
  arenaria, Gaud.

GRAMINEÆ.

Aristida behriana, F.v.M.
    leptopoda, Benth.
    ramosa, R.Br.
    calycina, R.Br.
Stipa elegantissima, Labill.
    tuckeri, F.v.M.
    setacea, R.Br.
    aristiglumis, F.v.M.
    scabra, Lindl.
Deyeuxia forsteri, Kunth.†
Avena fatua, Linn.*
Amphibromus neesii, Steud.†
Danthonia bipartita, F.v.M.†
    pallida, R.Br.†
    semiannularis, R.Br.†
Amphipogon strictus, R.Br.†
Pappophorum nigricans, R.Br.†
    avenaceum, Lindl.†
Astrebla pectinata, F.v.M.†
    triticoides, F.v.M., et var.†
    elymoides, F.v.M.†
Triraphis mollis, R.Br., et var.†
Triodia mitchelli, Benth.
    pungens, R.Br.
    irritans, R.Br.
Cynodon dactylon, Pers.†
Chloris acicularis, Lindl.†
    truncata, R.Br., et var.†
    ventricosa, R.Br., et var.
Eleusine ægyptiaca, Pers.†
Leptochloa subdigitata, Trin.
Diplachne loliiformis, F.v.M.
    fusca, Beauv.†
Sporobolus virginicus, Kunth., var. *pallida*.†
    indicus, R.Br.†
    pulchellus, R.Br.

GRAMINEÆ.

- *Sporobolus lindleyi*, Benth.†
  - *actinocladus*, F.v.M.
- *Eriachne aristidea*, F.v.M.
  - *obtusa*, R.Br.†
- *Ectrosia leporina*, R.Br., et var.
- *Lamarckia aurea*, Mœnch.*
- *Phragmites communis*, Trin.
- *Elythrophorus articulatus*, Beauv.
- *Eragrostis tenella*, Beauv.
  - *megalosperma*, F.v.M.
  - *pilosa*, Beauv.†
  - *kennedyæ*, Tur.
  - *brownii*, Nees.
  - *laniflora*, Benth.
  - *eriopoda*, Benth.
  - *chætophylla*, Steud.
  - *lacunaria*, F.v.M.†
  - *falcata*, Gaud.
- *Poa annua*, Linn.*
  - *lepida*, F.v.M.
- *Glyceria fordeana*, F.v.M.†
  - *ramigera*, F.v.M.†
- *Bromus arenarius*, Labill., et var.†
- *Ceratochloa unioloides*, DC.*
- *Agropyrum scabrum*, Beauv.†
- *Lepturus cylindricus*, Trin.
- *Hordeum murinum*, Linn.*

Class III. ACOTYLEDONS, Juss.

LYCOPODIACEÆ, Swartz.

- *Azolla pinnata*, R.Br.
  - *rubra*, R.Br.

MARSILEACEÆ, R.Br.

- *Marsilea drummondii*, A.Br.†

FILICES, Linn.

- *Cheilanthus tenuifolia*, Swartz.
- *Notholæna vellea*, R.Br.

NOTES ON PROSOBRANCHIATA.

No. iii.—THE NEANIC SHELL OF *MELO DIADEMA*, LAMK., AND THE DEFINITION OF THE NEPIONIC STAGE IN THE GASTEROPOD MOLLUSC.

BY H. LEIGHTON KESTEVEN.

(From the Biological Laboratory, Sydney University).

A. NEANIC SHELL OF *Melo diadema*, Lamk.
  (1) Description of shell and mass of egg-capsules.
  (2) The succession of the columellar folds.
B. DEFINITION OF THE NEPIONIC STAGE IN THE GASTEROPOD MOLLUSC.
  (1) A comparison of Molluscan stages of development with those of the *Lepidoptera*.
  (2) Three types of transition from Embryonic to Neanic shell-structure, and suggestions as to their explanation and significance.
  (3) Conclusions arrived at.
C. A SHORT LIST OF WORKS IN WHICH PROTOCONCHS ARE DESCRIBED, OR IN WHICH THE AUXOLOGICAL TERMS ARE DISCUSSED.

A. NEANIC SHELL OF *MELO DIADEMA*, Lamarck.

Description of shell and mass of egg-capsules.—The following remarks are to some extent inspired by a short note by Mr. B. B. Woodward* on the nepionic shells of *M. indicus*, Gmel., in a recent part of the Proceedings of the Malacological Society. His note led me to examine similar specimens of *M. diadema*, Lamk., and apices of many other *Volutes;* and I have arrived at the conclusion that it is probable that the formation of adult structure within the egg-capsule is common to many of the Volutidæ, if not all.

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* Woodward, Proc. Malac. Soc. Lond., v., No. 4, 1803, p. 260.

The capsule mass is oval in transverse and longitudinal section; its dimensions are 155 × 60 × 50 millimetres, and was apparently attached by one end; it contains about eighty individuals, all with their apices turned outward and their anterior canals towards the centre.

As far as may be judged from young specimens of *M. indicus* at my disposal, the shell of *M. diadema* when it bursts the capsule is similar to those on which Mr. Woodward founded his remarks.

Specimens which entirely fill their respective capsules consist of a protoconch of three and one-half whorls, and one-half whorl of adult structure. Such a specimen measures 28 mm. in length and 16 in breadth, the length of the aperture being 21 mm. The crown of the spire is flat, the nucleus being slightly depressed. The protoconch is very faintly defined from the succeeding structure by the possession of obsolescent revolving liræ, and a slight and somewhat abrupt thickening of the shell. It is probable that this protoconch was cast inside a horny original, which was discarded at an earlier stage than I have been able to study.

Dr. Dall* was able to demonstrate that the protoconch of *Scaphella magellanica*, Sby., was cast inside a horny original.

This calcareous cast of a primitive horny shell, when it has been deposited subsequent to the veliger, is in the following pages designated the *pseudoprotoconch*, in contradistinction to the true protoconch, which was secreted previous to or during the veliger. Many true protoconchs are, however, calcareous, as for example those of the various species of *Triphora*.

The succession of the columellar folds.—Before proceeding to discuss the definition of the nepionic stage, it will be in order to draw attention to the sequence of the acquisition of the columellar plaits. This is of particular interest, as being in perfect conformity with Dr. Dall's† phylogenetic scheme of their origin, viz.:—The first to appear is the anterior, and the last the posterior, this last being subsequently aborted. The anterior, which in

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* Dall, Bull. Mus. Comp. Zool. Harvard, xviii., 1889, p. 452.

† Dall, Wagner F. Inst. Sci. iii., pt. 1, 1889, p. 58 *et seq.*

Melo is merely an emphasis of the columellar edge, appears on the protoconch (pseudoprotoconch ?) when only two whorls have been formed; the third follows so soon after the second that they may be said to arise simultaneously, on the completion of two and one-half whorls; the fourth arises a quarter of a whorl later. The last gradually degenerates after the formation of five whorls, and has generally disappeared by the time six and one-half whorls are completed, though it may occasionally persist throughout the ephebic stages.

For reasons stated in the next section of this paper, the structure which follows the protoconch (pseudoprotoconch ?) in *M. diadema* is to be regarded as neanic, and it is interesting to find that though there is no external differentiation, the neanic stages are clearly defined, by the retention of the fourth fold.

The order of succession of the plaits in *M. æthiopica*, Linn., is doubtless on the same lines as in the above species; there are generally only three plaits present in adult specimens, but one example of eight whorls had all four plaits fully developed.

The position of this fourth plait is always on the posterior boundary of the sinūs left in the track of the anterior canal. It is possible that the ridge sometimes present at the posterior boundary of these sinūs is the cause of the occasional retention of the plait.

B. DEFINITION OF THE NEPIONIC STAGE IN THE GASTEROPOD MOLLUSC.

Recent papers dealing with protoconchs provide a fairly wide range of facts, which may be taken as the basis of speculation on this interesting minor problem.

The nepionic (brephic or silphologic) stage was defined by Buckman & Bather* as that immediately succeeding the embryonic stages, and during which no specific characters make their appearance. The next, neanic (nealogic) stage they defined as that during which specific characters and all other morphological features present in the adult, appear and undergo development.

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* No. 15 appended bibliography.

Both Harris and Jackson (7, 16) conclude that specific characters make their appearance in the nepionic stage. This conclusion was, however, it is here contended, due to the misapplication of the terms, the stage in which they recognised these specific characters being the neanic.

That the nepionic stage, as defined above, exists throughout whole orders no student of Ontogeny will deny. To cite the example used later, the short stage during which the Lepidopterous larva changes into the pupa cannot be regarded as embryonic, neither can it be regarded as neanic, for certainly no specific characters appear until the formation of the pupa, which must therefore be regarded as neanic. Specific characters *almost invariably* make their appearance in what these authors call the nepionic (brephic) stage of the Gasteropoda. From an extended study of *Lotorium* growth-stages, I find that it is possible to identify almost any species of that genus from one-half whorl of post-embryonic structure. On the other hand, it is often possible to recognise a species from purely embryonic characters, *e.g.*, *Triphora*. But what is desired here is to point out that there *are* whole orders in which the nepionic stage as above defined is *easily* recognisable, whilst with the Gasteropoda, in that stage which has hitherto been designated nepionic (brephic), specific characters are generally recognisable. That is to say, the various species of a given genus are already differentiated one from another in that stage. The explanation lies in the fact that in this class (Gasteropoda) the true nepionic stage is a very transitory one, and leaves, in most cases, no conchylaceous record. If this be not recognised, the auxological terms will have one set of meanings for Mollusca and another for other organisms.

Comparison of Molluscan stages of development with those of the Lepidoptera.—That the various stages of development may be the better understood, it will be well to apply the auxological terms to the Lepidoptera; organisms in which the primary divisions are emphasised and easily definable, and then to homologise the molluscan stages with them.

The embryonic stage closes with the larva, which is the phylembryo. The pupa has acquired the adult organs and must therefore be regarded as the neanic stage, since it is that in which the adult characters first appear. The nepionic stage must consequently be, in a silkworm for example, that during which it spins its cocoon and becomes metamorphosed into the pupa. The imago is the ephebic stage.

Homologising the molluscan stages with the above, the veliger is the phylembryo. The nepionic stage is so contracted as to be generally unrecognisable and (probably) non-existent conchylaceously. It is however, here as in the *Lepidoptera*, that stage during which the larval organs degenerate and disappear. The neanic stage during which the adult characters appear and undergo development is generally so graduated into the succeeding ephebic stage that only in a few instances can its ultimate limit be defined. Early adult shell-structure is, however, doubtless neanic, as is also the pseudoprotoconch.

Three types of transition from embryonic to neanic shell-structure, and suggestions as to their explanation and significance.—The investigations of the writers mentioned in the appended bibliography have brought to light three very distinct types of transition from embryonic to neanic shell-structure, viz.:—

(1) Those in which the embryonic is faintly, if at all, defined from subsequent structure. Examples are *Melo indicus*, *Lotorium abbotti*, Tenison-Woods, and most species of *Triphora*.

(2) Those in which there is an abrupt change from embryonic to subsequent structure. This occurs in all the recent species of *Lotorium*.

(3) Those in which a varix is thrown up at the conclusion of the protoconch before the neanic structure is initiated. According to F. C. Baker* most of the Murices fall into this category.

Remembering that the primitive shell-gland is distinct from the area which secretes the adult or, as Lankester† aptly terms it, secondary shell, the following suggestions are advanced in explanation of the above types of transition.

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* Baker, Proc. Acad. Nat. Sci. Philad., 1890, p. 66 *et seq.*

† Lankester, Ency. Brit. edit. 9, xvi., p. 639, 1885.

In the first type it seems probable that, parallel with the gradual cessation of functional activity on the part of the primitive shell-gland, there was a gradual assumption of secretive activity on the part of the epithelial cells of the mantle and visceral hump. In *Melo* the acceleration of development which the formation of neanic structure within the egg-capsule presents, points to a correspondingly transitory nepionic stage, consequently there is only a slight defining line. It is evident from the weight and size of the neanic shell described above that, as in *Neritina* and *Onchidium*, the veliger stage of *M. diadema* is passed within the egg. In *Triphora*, on the other hand, there is an extreme protraction of the veliger stage; it has been obtained in mid-ocean with several adult whorls already formed. In this genus the true embryonic shell or protoconch is calcareous. Doubtless the original cap of the smooth nucleus was horny; we are nevertheless not dealing with a pseudoprotoconch, for whilst still a veliger or phylembryo the organism had acquired the ability to secrete a calcareous shell. The explanation given at the beginning of this paragraph still applies, but in this instance the transference of functional activity from the primary to the secondary shell-secreting area took place some time prior to the nepionic stage. The protracted retention of the velum here allows a much greater development of the other organs, so that the mantle edge assumes its adult form and secretes shell-structure which, although genetically embryonic, is morphologically adult. The other organs being well advanced in development, the nepionic stage is concerned only with the degeneration of the velum, in these instances also it will be very condensed. From these remarks it may be reasonably expected that this type of transition will prove to be correlated with an extremely condensed nepionic stage.

The metamorphosis of organs just mentioned appears at first sight to be nepionic, but as long as the organism retains the velum in full development it is to be regarded as a phylembryo;

if this be not admitted, it becomes impossible to define the embryonic stages.

Taking as my base the genus *Lotorium*, in examining the second type of transition I am presented with the following facts. The true protoconch is horny and contains practically no calcareous matter. During the formation of at least part of this, the organism is a free-swimming veliger; the same applies to *Gyrineum australasia*, Perry. The next stage I am acquainted with is that in which a little less than half a whorl of neanic structure has been added. The protoconch has now deposited within it distinct traces of the pseudoprotoconch in the form of an extremely thin layer of calcareous lining, the neanic structure being much thicker and exhibiting the adult sculpture in miniature. The mollusc itself is sedentary and has lost all traces of the velum. The abrupt transition from one structure to the other may be explained by the sudden functional activity of the secondary shell-secreting area. It is probable that during the nepionic stage, which was slightly protracted, there was a complete cessation of shell-growth, and that the primitive gland had ceased its function before the secondary shell was initiated.

As an example of the third class of transition, perhaps the rarest and most interesting, *Murex denudata*, Perry, exhibits the following characters:—A stout calcareous protoconch longitudinally sculptured, followed by a prominent varix, the succeeding neanic structure exhibiting, in miniature, all the adult characters. The sculpture of the protoconch is such as to prove conclusively that it was not cast inside a horny mould and is therefore a true protoconch. *The embryo thus had the ability to secrete a calcareous shell.* It seems reasonable to suppose that during the nepionic stage (during which there must generally be a longer or shorter pause in the growth of the mollusc) the secretion of shell was carried on by the free edge of the mantle. Granted this, the varix may be looked upon as the conchylaceous record of the nepionic stage.

Conclusions arrived at.—The perfection of internal organs during the veliger stage, postulated above for *Triphora*, has been demonstrated in other Mollusca;* we are therefore led to the following definition of the nepionic stage in the Gasteropod mollusc :—*That stage during which the velum undergoes degeneration and disappears.*

And a theory I advanced some time ago is still maintained, namely :—*Where no varix is thrown up at the conclusion of the embryonic shell, no conchylaceous record of the nepionic stage has been left by the mollusc.*

A more explicit definition of the nepionic stage than Buckman and Bather's would be :—That stage during which the larval organs become aborted. The above definition of this stage in the Gasteropod Mollusc is, therefore, only a specific form of the general definition.

It has been suggested to me in the course of discussion that the pseudoprotoconch is the homologue of the above varix. This suggestion is a good one, and it is likely that some pseudoprotoconchs are nepionic, but it does not apply to those of *Lotorium*, as shown by the extreme thinness of the calcareous lining of the young specimen described above.

C. A SHORT LIST OF WORKS IN WHICH PROTOCONCHS ARE DESCRIBED, OR IN WHICH THE AUXOLOGICAL TERMS ARE DISCUSSED.

1.—BAKER, F. C.—"On the Modifications of the Apex in *Murex*." Proc. Acad. Nat. Sci. Philadelphia, 1890, p. 66 *et seq.*

2.————————"Descriptions of New Species of *Murices*, with remarks on the Apices of certain forms." Proc. Rochester Acad. Sci. I, 1891, p. 129 *et seq.*

3.————————"Modification of the Apex in Gasteropod Mollusks." Ann. New York Acad. Sci. ix., 1897, p. 685 *et seq.*

4.—DALL, W. H.—"Blake Mollusca." Pt. ii. Bull. Mus. Comp. Zool. Harvard Coll. xviii., 1898.

5.————————"Tertiary Mollusca of Florida." Trans. Wagner Free Inst. Sci. iii., pts. 1 and 2, 1890 and 1892.

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* Fide Korschelt & Heider, Text Book of Emb. Invert. M. F. Woodward's edit., iv., p. 133.

6.—GRABAW, A. W.—"Studies of Gasteropoda." American Naturalist, xxxvi., No. 432, 1892, p. 917 *et seq.*

7.—HARRIS, G. F.—Brit. Mus. Cat. Tertiary Mollusca. Pt. i. Australasia, 1897.

8.—HEDLEY, C.—*Triforis* in "The Mollusca of Funafuti." Mem. Australian Mus. iii., Pt. 7, 1899, pp. 439-448.

9.————————"The Triphoridæ of New South Wales" in "Studies on Australian Mollusca, Pt. 7." Proc. Linn. Soc. N.S. Wales, xxvii. Pt. 4, p. 606 *et seq.*

10.—KESTEVEN, H. LEIGHTON.—"The Systematic Position of *Purpura tritoniformis*, of Blainville." Proc. Linn. Soc. N.S. Wales, xxvi. Pt. 4, 1902, p. 533 *et seq.*

11.————————————"The Protoconchs of Certain Port Jackson Gasteropods." *Loc. cit.* p. 709 *et seq.*

12.————————————"A Note on two species of *Astralium* from Port Jackson." *Op. cit.* xxvii. Pt. 1, 1902, p. 2 *et seq.*

13.————————————"Notes on *Prosobranchiata.* No. 1. *Lotorium.*" *Op. cit.* Pt. 3, p. 443 *et seq.*

14.—WATSON, R. B.—"Gasteropoda." Challenger Reports, Zoology, xv., 1886.

The above list might have been lengthened by enumerating papers in which one or two apices are described incidentally, in specific definitions, but it contains the most important works, and their consultation will give references to many others. Several of the text-books contain interesting remarks on the subject and are well worth consulting. Tate's papers on the "Gasteropods of the Older Tertiaries of Australia" give several short descriptions and a few figures of apices. The following are the works in which the auxological terms have been discussed:—

15.—BUCKMAN, S. S., and BATHER, F. A.—"The Terms of Auxology." Zoologischer Anzeiger, No. 405, 1892, p. 421; No. 406, p. 429.

16.—HYATT, A.—"Values in Classification of the Stages of Growth and Decline, with Propositions for a new Nomenclature." Proc. Boston Soc. Nat. Hist. xxiii. 1888, pp. 396-408.

17.————————"Genesis of The Arietidæ." Mem. Mus. Comp. Zool. Harvard Coll. xvi. No. 3, 1889.

18.—HYATT, A. "The Terms of 'Bioplastology,' 'Ontogeny.'" Zoologischer Anzeiger No. 427, 1893, p. 325.

19.—JACKSON.—"Phylogeny of the Pelecypoda." Memoirs Boston Soc. Nat. Hist. iv. No. 8, 1890, p. 290.

POSTSCRIPT.—After this paper was read Mr. C Hedley drew my attention to a paper by Dr Willey,* "On the Nepionic Shell of the Recent *Nautilus*," in which the author regards the date of hatching as the date of the conclusion of the nepionic stage. He says :—"Thus the nepionic shell of the ('terrestrial Gasteropod') molluscs is that portion of the true shell (as opposed to the embryonic shell), which develops within the egg." This, I venture to suggest, is a misinterpretation of the term. If we accept, as we must, Dr. Jackson's definition of the Molluscan phylembryo as the veliger and last embryonic stage; and if the velum becomes aborted within the egg, however quickly; then that stage during which this "larval organ" is aborted, must, as in other cases, be recognised. Thus, such a mollusc, terrestrial or otherwise, has already entered upon the neanic stage before leaving the egg. Some Anuran Amphibia are hatched in the adult form, but we do not regard them as tadpoles, because most of the Anura are hatched as tadpoles. We cannot say what stage of development *Nautilus* is hatched in, so that the shells discussed by Dr. Willey in the paper referred to may be rightly termed "nepionic"; on the other hand they might equally well be neanic *(September 25th, 1903)*.

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* Willey, Quart. Journ. Microscop. Sci., xxxix., pp. 222-230, 1897.

[Printed off September 30th, 1903.]

NOTES ON THE GENUS *PSYCHOPSIS*, NEWMAN, WITH DESCRIPTIONS OF NEW SPECIES.

BY WALTER W. FROGGATT, F.L.S., GOVERNMENT ENTOMOLOGIST.

(Plate xxi.)

Since my former contribution* to the study of these beautiful Neuroptera, I have obtained a fine series of specimens of all the described species, through the kindness of my Correspondents in various parts of Australia: and among them some from the vicinity of Adelaide, S.A., where Newman's type was obtained over sixty years ago.

From a comparison of the specimens now available, it is quite evident to me that two species which can be well defined and are constant in their markings, have been both placed in our Museum collections under the name of *Psychopsis mimica.* In his description of the type, Newman does not mention the rich red colour in the blotches on the forewings, so typical in the second form; nor are they shown in the woodcut given on the title-page of the second volume of the 'Entomologist.'

The brief description given in my former paper under the name of *P. mimica*, therefore, applies to the one to which I now propose to give specific rank, under the name of *Psychopsis newmani.* Both the species in question seem to have much the same range, but, being rare insects, they are not common in collections. Mr. Lea informs me that he has never seen them in any Tasmanian collection. One (probably Newman's) is found in Western Australia.

The note on *P. cœlivagus* in my former paper, applies to *P. insolens*, for the former, though the smallest of the genus, is one of the most beautiful.

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* These Proceedings, 1902, p. 367.

PSYCHOPSIS NEWMANI, sp.n.

(Plate xxi., figs. 1-2.)

Psychopsis mimica, Newm., Froggatt, Proc. Linn. Soc. N.S. Wales, 1902, p. 367.

Length across outspread wings 1¾ inches, not 2½ as given in former description.

General colour distinctly buff instead of a delicate creamy-white tint, red colouration of the blotches on forwings well defined; the transverse black pencil-like lines on the front margin of forewings consisting of only two pair, both of which run out from the blotches.

Hab.—Sydney (W. W. Froggatt), and Blue Mts., N.S.W. (J. Kershaw; Brisbane, Q. (R. Illidge).

PSYCHOPSIS MIMICA, Newman.

(Plate xxi., figs. 3-5.)

Length across outspread wings about the same as in the preceding; but both are variable in size, some being much smaller than the measurements given would indicate.

General colour creamy-white, the red spots or blotches at the base of forewings of the preceding species replaced by two small brown marks; the larger blotches towards tip of hind margins in *P. newmani* replaced by a slender curved line enclosing the black spots on the edge. Transverse bars consisting of pairs of slender pencil-like lines, four in number, running out to front margin. Central spot on hind wings generally smaller and darker.

Hab.—Adelaide, S.A. (J. G. O. Tepper); Inglewood, Vic. (G. Lyell); Young, N.S.W. (W. W. Froggatt).

PSYCHOPSIS INSOLENS, McLachlan.

(Plate xxi., fig. 6.)

This appears to be the commonest species. There is a fine series in the Brisbane Museum, taken about Moreton Bay. McLachlan says that there are a number in the British Museum;

and there are others in the Macleay Museum, which Mr. Masters informs me were taken about Sydney some twenty years ago, when it was comparatively common. It is somewhat smaller than the former species, and of a uniform dull brownish tint, with faint tracings of spots and marks on the fore and hindwings; and might be compared to a dull-coloured rubbed specimen of *P. mimica*. The species I placed under *P. cœlivagus*, Walk., in my former paper is this species.

Hab.—Brisbane, Q., and Sydney, N.S.W.

PSYCHOPSIS CŒLIVAGUS, Walker.

(Plate xxi., fig. 8.)

Length across outspread wings 1 inch; body 4 lines.

Dorsal surface of head, thorax and abdomen black; undersurface of head and thorax marked with reddish-brown, all clothed with fine white hairs. Antennæ composed of 16 short, rounded joints, ochreous at base, darker and more fusiform to tip. Legs light brown. Forewings semi-transparent, with opaline tints, and clothed with fine grey hairs; a broad dark reddish-brown band, composed of one small and five large dark brown blotches surrounded with lighter brown (giving off rich coppery reflections) occupying the front portion of the wings, curving round at the apex. Outer edges and hind margin mottled with light brown; hindwings white, with basal portions lightly marked with brown, and a very fine black spot in the centre.

Hab.—Brisbane, Q. (R. Illidge; one specimen).

Walker described his type in 1853. I have never seen a specimen in any Australian collection.

PSYCHOPSIS ILLIDGEI, n.sp.

(Plate xxi., figs. 7 and 9.)

Length across outspread wings 2½ inches; body ¾ inch.

General colour creamy-white, clothed with fine silvery hairs, masked with yellowish-brown. Head, thorax, legs and basal joints of antennæ yellow, clothed with hairs of same colour. Eyes black. Antennæ, except first and second joints, reddish-brown, covered with a fine pubescence. Forewing broad, rounded, spotted along front margin with light brown, in centre towards tips ornamented with an embossed irregular rounded blotch, 4 lines in diameter, deep yellowish-brown, clothed with ochreous hairs, connected by a more ochreous-coloured transverse band crossing to hind margin where, clothed with dark brown hairs, it forms another irregular blotch, mottled with white, and a row of fine bead-like spots on the transverse band; turning upward an irregular ochreous band crosses hind portion of wing, enlarged into another irregular blotch close to sides of thorax, also mottled with grey and brown. Hindwings smaller, rounded, with a rounded dark brown blotch in centre, towards tips of wings a few small brown spots. Abdomen short, rounded, swelling out at tip, and covered with grey hairs, thickest at the extremity. The remarkable blotching of the forewings of this beautiful insect might be likened to a drop of yellow varnish that had been placed on the wing close to the thorax, allowed to run down along the hind margin, and then turned up and allowed to remain on the embossed centre.

Hab.—Tambourine Mountain, Q. (R. Illidge; 2 specimens).

I am indebted to Mr. C. French for the first specimen of this beautiful insect. But I have since received a second from Mr. Illidge, who informs me that both were taken flying to a lighted lamp in the evening; and that in the course of forty years' collecting in Southern Queensland, he had never taken it before.

EXPLANATION OF PLATE XXI.

(*Note.*—The left-hand row, counting from the top, comprises figs. 1-5: the right-hand row, also counting from the top, comprises figs. 6-9).

Figs. 1-2.—*Psychopsis newmani*, n.sp.
Figs. 3-5.— ,, *mimica*, Newm.
Fig. 6.— ,, *insolens*, McL.
Fig. 7.— ,, *illidgei*, n.sp.
Fig. 8.— ,, *cœlivagus*, Walk.
Fig. 9.— ,, *illidgei*, n.sp.

THE CONTINENTAL ORIGIN OF FIJI.

By W. G. Woolnough, B.Sc., F.G.S.

Part I.—General Geology.

(Plates xxii.-xxxiv.)

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i.—Introduction.

The question of the probable continental origin of the larger islands of the Fiji Group has been discussed for many years with considerable interest. The evidence brought forward has been mainly biological, though a small amount of geological work has also been done.

ii.—Previous Work.

Owing to my very limited opportunities for collecting references, I fear my bibliography is very incomplete.

In 1851 A. A. Gould* noticed that if we consider the evidence afforded by the land shells, "the Samoan and Friendly Islands are more intimately related to the Society Islands, though at a much greater distance, than to the Feejee Islands. . . . Indeed, judging from the land shells, the Feejees are more nearly allied to the islands to the westward, such as the New Hebrides, than to the Friendly Islands on the east, though so much nearer."

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* **Quoted from Hedley's paper (13), not from the original.**

In 1892 Hedley (13, p. 400) claimed that the molluscan fauna indicates that Fiji must be regarded as the extreme eastern extension of the Melanesian Plateau.

In his "Zoogeographic Scheme for the Mid-Pacific" (13) he gives an admirable summary of the biological evidence for the continental origin of Fiji. He explains that the fauna and flora contain numerous species which cannot pass wide stretches of deep ocean, whilst the islands to the eastward (Tonga, Samoa, &c.) are populated only by such organisms as are capable of swimming, flying, or being blown or drifted, or otherwise transported across permanent deep water. The continental inhabitants of Fiji are not confined to a single or even to a few groups of the animal and vegetable kingdom, but are well distributed over the whole range. The vegetation, land molluscan fauna, marine molluscs, reptiles, land planarians, coleoptera, &c., all agree in pointing to this conclusion.

He says (p. 399), "From geological data it is evident that the Fijian group has undergone much recent upheaval; previous to which it certainly underwent great subsidence. Prior to that subsidence, it is generally admitted that the group stood at a level sufficiently high to unite such outlying islands as Kadavu* to the principal masses of Vanua Levu and Viti Levu. Such a union is indicated by the close affinity of their land molluscan fauna, and some measure of its antiquity is afforded by the specific differentiation which has arisen between corresponding species which represent each the other in different islands, as the various *Trochomorpha* and *Placostylus* do.

"The writer was the first to contend that this former elevation not only sufficed to amalgamate the separate islands, but to join the whole to the Solomon Group."

Ortmann (18) has shown that a like result is obtained by the study of the distribution of freshwater crustaceans. With regard to these Ortmann states that "according to Huxley (Tr. Zool. Soc. 1878, p. 771) *Paranephrops* is said to be found in the Fiji Islands. This locality is supported by two specimens in the British Museum, which are in a very bad condition; moreover there is no report as to the authenticity of the locality, and the genus has never again been reported from these islands." I may add that, though I made no biological collections, I noticed that on the upper tracts of some of the rivers (particularly the Upper Navua) a small species of "crayfish" is used as an article of food by the natives.

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* I have given the native spelling (W.G.W.).

In the same paper it is stated that von Ihering regards the date of separation of New Zealand and Fiji from Australia as being just Pre-Eocene.

Forbes (10) also advances very numerous arguments of a biological nature in support of the theory that Australia, New Zealand, and many of the smaller islands were connected in past geological time with South America by an Antarctic land-bridge.

The earliest geological evidence was obtained by Kleinschmidt, who visited these islands in 1876. The collections made by him for the Museum Godeffroy at Hamburg were examined by Wichmann (20), and the results published in 1883. The most important results obtained were the discovery of quartzite and quartz diorite *in situ* almost at the centre of Viti Levu. Wichmann also describes granite, quartz porphyry, syenite porphyry, foyaite, &c. Most of these were collected amongst the very extensive and varied river gravels of the island.

More recently Eakle (9) has described the rocks collected by Agassiz. Amongst others he describes a dioritic granite from Vatu Lola in the interior of Viti Levu, but it is not certain that this was *in situ*.

Andrews (2) observed the bedded limestones of the Sigatoka-Cuvu District and also the massive limestone of Qali Mari on the Sigatoka.

iii.—GEOGRAPHY.*

The Fiji Group consists of about two hundred islands of different sizes within the area bounded by 176° East longitude, 178° West longitude, 16° South latitude and 21° South latitude. Of these islands two are very much larger than any of the others, namely, Viti Levu and Vanua Levu. A great number of the smaller islands, especially those of the Lau Group to the east, have been geologically examined by Prof. Agassiz, Mr. Stanley Gardiner, and Mr. E. C. Andrews. They have been proved to consist of volcanic rocks (mainly andesite and andesite tuff), raised coral reefs, or both. None of them contain crystalline schists or plutonic rocks.

Vanua Levu, the smaller of the two large islands, has a length of about 120 miles and a breadth of 30. I was unable to visit this island, but it is said to contain rocks similar to those described in this paper.

Viti Levu, the largest of the islands, has a length of 85 miles and a maximum breadth of 60 miles. It is roughly elliptical in shape, and has an area of about 4000 square miles. With the exception of the delta of the Rewa River, the country is extremely rugged, the highest points in the districts visited being Tama ni Ivi 4555 feet, Mua ni Vatu 4000, and Korobasabasaga 3960.

As might be expected from the great annual rainfall, the river systems are extensive and important for so small an area. The largest of these, the Rewa, together with all its branches, has a total length of over 200 miles. This drains the greater part of the eastern half of the island.

The Sigatoka is another large river in the western part of the island.

Between these is the Navua, a much less extensive stream.

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* All names are spelt in the native fashion, as I have found from experience how difficult it is for an observer to follow up information if names are translated or spelt unusually.

N.B.—The vowels have French sounds. Of the consonants *b*=*mb*, *c*=*th*, *d*=*nd*, *g*=*ng* (soft), *q*=*ng* (hard).

All the above empty on the southern side of Viti Levu. The only other important streams are, on the north the Ba, and on the west the Nadi.

The nearest land to the east is the Tonga Group (Friendly Islands), distant about 360 miles. Deep soundings (1445, 1320, 1211, 928, 1875, 1397 fathoms respectively) have been obtained between the two groups. No continental rocks have been described *in situ* from these islands, which are composed of volcanic materials and corals. At Eua (one of the group) Lister* mentions red garnet and tourmaline amongst the volcanic fragments and a boulder of "uralitized gabbro."

To the west are the New Hebrides and New Caledonia, distant about 550 and 900 miles respectively. In both these places continental rocks are extensively developed, as described later. It is the object of the present paper to show that, geologically, Fiji is far more closely related to New Caledonia than to the Friendly Islands.

iv.—NARRATIVE.

In December, 1900, Professor David, of the Sydney University, received a letter from Professor Judd pointing out some of the above facts, and suggesting the importance of determining whether the continental rocks above described existed *in situ* or were merely enclosures in volcanic rocks, or possibly represented the plutonic reservoirs of a series of enormously denuded volcanoes.

In Wichmann's paper, the statement is very definitely made that the quartzite and granite of Na Rokorokoyawa are *in situ*. Wichmann also concludes that Fiji is certainly of continental origin. The paper referred to was not available in Sydney at the time of my departure.

As Professor David was unable, through pressure of work in connection with the Funafuti Coral Boring Expeditions, to undertake the work himself, he very kindly proposed that I, his Demonstrator at the time, should make the expedition. I proceeded to Fiji at the beginning of January, 1901, and spent six weeks in geologically exploring the largest island of the group, Viti Levu. Through the valuable advice of the Hon. Dr. Corney, Chief Medical Officer to the Fiji Government, I was enabled to start work without waste of time. Dr. Corney has proved himself to be an exceptionally keen and careful scientific observer. His intimate knowledge of the country and the people was of the utmost service to me. He sketched out the route which would probably give the most valuable results, and thus enabled me to attack the work without loss of time in preliminary trials. Any success which I may have attained is due in no small measure to his assistance.

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* Q.J.G.S. xlvii., pp. 590 *et seq.*

Owing to the limited time at my disposal nothing like a detailed survey could be attempted, and the difficulties of even a sketch survey were enormous. The work had to be carried out during the University long vacation—that is, in January and February, during which months the climate in Fiji is at its very worst, and is very enervating. The dense vegetation makes it impossible to travel except along the regular tracks unless one has a couple of men to cut a way through the jungle. The tracks follow the river alluvials, fording the stream every mile or two. Owing to the strong current the deeper fords are very dangerous. The rainfall at Nadarivatu, near the water-parting between the Rewa and Sigatoka Rivers, for January, February and March, reached 147 inches. This caused heavy floods in both rivers, which involved the loss of a great deal of time, and rendered many interesting and important sections inaccessible. My resources did not permit me to engage sufficient porters for the transport of provisions, so that I was compelled to rely mainly on native food, a thing which tells against a European doing heavy work in the tropics. I was still further hampered by the desertion of my interpreter three days out of Suva.

Good geological sections accessible in the time at my disposal were comparatively rare.

Starting from Suva, I struck across country to the Rewa at Nausori, and followed the river up to Naocokaika, where I left the main stream and crossed the hills to the Waidina Valley at Sovu.

While flood-bound at Nabukaluka, I made a short excursion up the Wai ni Valau, and examined the group of mountains of which Buki Levu is the chief. After resuming my journey I followed the Waidina River almost to its source. From the head of the Waidina the track crosses the water-parting into the valley of the Navua River, a little below Korowaiwai. This stream was then followed to the head of the Wainibua branch, and the pass of Navunitorilau crossed into the valley of the Wainimala. I followed the Wainimala to its junction with the Wailoa, and thence up the latter stream, and by way of Nubumakita and Nasoqo over the shoulder of Tama ni Ivi (Mt. Victoria) to Nadarivatu. From Nadarivatu I made an excursion to the North Coast at Tavua, thus completing the traverse of the main island in a general north and south direction.

The return section was carried from Nadarivatu to Nadrau on the Sigatoka River, and thence down the stream to Natuatuacoko at the head of canoe-navigation. This part of the section was very much hurried on account of the approach of a flood. From Natuatuacoko to Rarayaka I journeyed in a canoe on the heavily flooded river, and so did no geology. From Rarayaka I cut across to the coast at the mouth of the Sovi River, a little west of the town of Vatukarasa, thence eastwards along the coast to Korolevu, where I found a cutter just returning to Suva. I, therefore, performed the rest of the journey by water.

The map is only approximately correct as regards the interior, which has never been surveyed.

At this point I may fittingly acknowledge my indebtedness to the following gentlemen for assistance, hospitality, and advice :— Drs. Montague and Pryor, Rev. H. Nolan, Messrs. C. R. Swayne, A. Joske, C. C. Chalmers and H. Smee; and I wish to express to them my sincere thanks for their many kindnesses.

V.—THE GEOLOGICAL SECTIONS.

1. *Suva to Tavua (on the North Coast).*

About one mile north of Suva, on a branch of the harbour known as Walu Bay, there is an interesting and instructive section

(Plate xxii., figs. 1-2). From the bank of the creek there is a long steep slope of talus leading up to the face of a cliff. The lowest exposure in the cliff consists of a well marked bed of conglomerate containing large, perfectly rounded pebbles of a great variety of rocks. Amongst these an undoubted quartz schist occurs, showing that the Fiji area must have undergone considerable dynamic metamorphism at a period prior to the formation of the conglomerate. Ss far as I am aware, dynamic metamorphism, powerful enough to give rise to a quartz schist, is confined to continental areas. At all events, we have distinct evidence of a considerable land-mass existing at the time the conglomerate was formed. Overlying the conglomerate is an upraised reef with corals *in situ*. This has yielded a considerable number of fossils of various kinds, the assemblage of which appears to indicate that the bed is not newer than Pliocene. Conspicuous amongst these fossils are the teeth of a large *Carcharodon* (Plate xxiii., fig. 3).

Above the limestone we pass to soapstone, which is here sufficiently coherent to be quarried and used for building stone. At the quarry itself the bedding is just about horizontal, but in the road, about a mile to the north, a southerly dip of about 5° to 7° is encountered.

This section, like those at Nasoqo and Nadrau (to be described hereafter) gives us positive proof of elevation of the land since early Tertiary time, and also indicates that, before the upheaval took place, areas of very much more ancient rocks were exposed at no great distance.

From Suva to Nausori nothing but "soapstone" was observed except at Kalabu, where coarse andesite breccia, fairly coarse tuffs, and shell-bearing tuffs occur.

About Nausori the alluvial flats are fairly extensive, and alternate with remarkably steep bluffs of "soapstone." The soapstone, which is here at any rate fine redistributed volcanic tuff, is rather carbonaceous. It is interstratified with thin layers of pure river sand from $\frac{1}{8}$ to $\frac{1}{2}$ inch in thickness. These latter evidently represent the material brought down in flood time. Here and there subfossil twigs are abundant, forming thin layers of lignitic material. This formation is apparently estuarine. Passing up the river, the soapstone hills close in, and the alluvials become less extensive.

In the Waidina Valley nothing but soapstone is visible as far as Nabukaluka. The river was flooded, so that very little of the gravel was visible, and none at all for the latter part of the distance. The pebbles consist mainly of granite and andesites. The tuffs throughout this district are almost level-bedded. They are of the typical yellowish-grey colour of "soapstone"; in fact the finer members are typical soapstones. Many of them are rather coarser than typical soapstone, and contain small but highly perfect augite crystals. All exhibit spheroidal weathering, but it reaches its highest perfection in the fine varieties. The creeks entering the river from the southwards contain no rocks or pebbles other than tuffs, so that these must extend for a considerable distance in that direction.

Whilst flood-bound at Nabukaluka I made an excursion about five miles up the Wainivalau. The first three miles crossed the monotonous tuff hills, and brought me to the foot of the pile of mountains grouped about Buki Levu as the centre. The contrast in outline and in vegetation between these hills and those composed of soft tuff is very marked. The mountains form the south-eastern termination of the high and excessively rugged mountainous portion of the interior of the island. Their junction with the tuff hills to the east can be traced by the contour of the country for at least ten miles in a north-south direction. They are built up of enormously massive beds of agglomerate, which are certainly scores—probably hundreds—of feet thick. The boulders in them are as much as six feet in diameter, and are subangular to rounded in shape. No sign of dip could be observed. Associated with these agglomerates are beds of tuff and solid sheets of andesite lava. I found no boulders of granite, quartzite or other continental rocks, either here or in any of the other agglomerates which were examined in various parts of the island. At a point about a mile below Nadakuni a large patch of gravel was exposed. It contained pebbles of granite, andesite, olivine basalt, and hard, jointed tuffs, up to four or five inches in length. The granite and jointed tuffs, which I believe to be very ancient, make up about one-third of the gravel. All the stones are thoroughly rounded. From this fact, as well as from their comparatively small size, I judge that they must have been transported a considerable distance, so that the outcrops must be a long way up stream. I think the course of the Wainivalau is shown incorrectly on the map. It certainly flows to the east of the mountains of the Buki Levu group, and from its volume at Nadakuni, must have a considerable extension above this point.

Viewed across a deep valley from the mountain Naroiyawa, and distant from it about two miles, Buki Levu is seen by means of field glasses to be composed very largely of agglomerates similar to that mentioned above. If there is any tendency to dip it is westwards. The slope of the mountain is highly suggestive of a volcanic neck. Its summit is about 3000 feet above sea-level. Behind—that is, to the north of Buki Levu—there are three well-marked ridges running, like it, about east and west. The middle one of these, Kororagigi, is distinctly razor-backed, and may represent a huge dyke. Kavu Kavu, distant about 12 or 14 miles, shows a solid outcrop near its western extremity. The rule was found to be of almost universal application throughout the expedition, that all cliffs are composed of agglomerate. Of course at the distance of Kavu Kavu it was impossible to make out details, but the outcrop was probably agglomerate.

The high hills are densely timbered, the foliage being of a dark green colour. The low tuff ridges are covered with lower vegetation, largely "reeds," which give the foliage a lighter and more yellowish tint. This fact, as well as the characteristic outlines, distinguishes the two formations even at considerable distances. The photograph (Plate xxiv., fig. 5) brings out the distinctions fairly well. In it Kororagigi and Kavu Kavu are almost completely hidden by mist and cloud.

In some of the creeks several miles to the south and east of the high hills the tuffs are bedded and sandy, and dip east at 15°, *i.e.*, away from the mountains.

At the village of Namasuleli or Wainiwaqa, on the Waidina, the agglomerate hills, forming cliffs hundreds of feet high, come close down to the northern bank of the river. The huge boulders can be plainly seen in the face of such a cliff at great distances.

From Namasuleli the agglomerate hills skirt the north bank of the river more or less closely for about five miles. At this point the river issues over extensive rapids through a magnificent gorge about half a mile wide bounded by cliffs estimated to be 600 feet high.

The river gravels consist, in addition to andesite, of large but well rounded boulders of quartz diorite and hornblendic granite.

Following the river up from the point where it issues from the mountains to its source, the country is extremely rugged, and consists of massive agglomerate hills with dykes and flows of solid andesite, and extensive coarse and fine tuffs.

Immediately after passing the gorge the mountain Devo forms a most remarkable object (Plate xxiii., fig. 4). It is really an enormous dyke which has been left standing as a wall, 200 to 300 feet (estimated) in height, through the denudation of the surrounding tuffs. From the gorge it is seen end on. Its summit must be considerably over 1000 feet high (above the river level). Its trend is about N.W. and S.E.

For some distance above Nasirotou the valley is considerably more open than it was lower down. After passing the above town the track leads across a spur, 485 feet (aneroid) high, built up of decomposed andesite tuff. From the western side of this a magnificent view is obtained of the great mountain of Korobasabasaga.* The mountain, whose highest summit reaches 3960 feet,† has five well-marked peaks whose shape even from a distance is highly suggestive of a line of denuded volcanic necks.

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* This name may be translated as "The Mountain with Ragged Peaks." The term is very appropriate.

† Admiralty chart.

At the village of Naseuvou, a little further on, there are two hot springs, or rather two groups of hot springs; and here for the first time plutonic rocks were met with *in situ*.

At the first spring the water issues from four irregular holes situated in a fissure in solid quartz diorite. The fissure is 5 inches wide by 8 feet long. It runs S. 32° E. and N. 32° W., and dips towards the south at 75°. A fifth small aperture is situated 3 feet 6 inches W. of the S.E. end of the main fissure. A second set of joints runs S. 65° W., the dip being E. 65° S. at 57°. Having no thermometer, I could not measure the temperature of the water. The heat was such that the hand could just be held in it indefinitely. A small quantity of gas is given off, but the odour was so faint I could not determine it. The fissure is lined by brown filiform plants.

A second spring is situated N. 18° E. of the first, and at a distance of about 40 yards from it. It rises from rock exactly similar to that described above. Only one set of joints is very marked, running S. 9° E. and almost vertical, but the jointing here is not nearly so regular as in the first case. The water is not quite so warm, and the plant growth more abundant.

The second group of springs is situated about three-quarters of a mile N.N.W. of the first. The vegetation here is extremely dense, so that nothing like a complete examination could be made. There must be quite a number of springs, as the ground for quite 100 yards round the main aperture consists of a very hot "slush," which makes examination difficult and rather painful. Quite a considerable stream of hot water is formed. The main fissure, which is only a few yards from the river bank, is an irregular hole in solid andesite agglomerate, about 3 feet by 2 feet, and 4 inches deep. In the centre is an inner opening about 9 inches in diameter, the total depth being about 14 to 15 inches (up to one's elbow). The water here is considerably hotter than that in the first spring, so that the hand cannot be held in it for more than an instant. The amount of gas evolved is considerable, and I fancied I was able to detect a slight odour of sulphuretted hydrogen. No plants occur in this basin. The Waidina gravels at this point contain numerous large pebbles of granite and diorite, particularly the latter.

About 3 miles above Naseuvou is the village of Delai Lasakau, situated at the junction of a fairly large affluent, the Wainivadu, with the main stream. This affluent contains subangular boulders of diorite several feet in diameter, so that it may safely be inferred that the diorite occurs *in situ* at some distance up the stream, which drains the country immediately to the east of Korobasabasaga. Owing to the swollen condition of the torrent, I was unable to locate the diorite *in situ* at this locality.

A subtributary entering the Wainivadu from the east contains only andesite pebbles derived from exceedingly solid sheets of that rock. This to some extent limits the area from which the diorite may have been derived.

In the gravels of the Waidina, above its junction with the Wainivadu, plutonic rocks are absent, so that no exposure of such rocks can exist anywhere in the area drained by the upper Waidina. Three miles above Delai Lasakau the hills close in round the river. They are composed almost entirely of andesite agglomerate and rise to heights of 500 to 700 feet (estimated) above the river.

From the village of Nailielie a good view is obtained of a range of hills extending in an almost unbroken line for 90° of the horizon. The outlines of these are very suggestive of the denuded remnants of a line of volcanic centres, as the photographs show (Plates xxv.-xxvi., figs. 7-8). The valley just at this point is considerably wider than usual. The trend of this line of hills is roughly N.W. and S.E.

After leaving this piece of open valley the river again enters the hills, and they continue right up to the source, the valley becoming simply a gorge never more than about one mile wide, often much less, bounded by perpendicular cliffs which in some cases rise to a height of fully 1500 feet (estimated). The rocks composing these cliffs are mostly enormously solid and coarse andesite agglomerate, the boulders being 3 to 4 feet in length. With these agglomerates are associated solid andesites. Some of the latter certainly represent volcanic "plugs." A very remarkable rock mass is met with in the mountain Namulowai (Plate xxvii., fig. 9). It consists of a mass of solid augite andesite shaped exactly like a thimble. The estimated height from base to summit is about 250 feet. It is split up by vertical joints so as to possess an obscurely prismatic structure. Its position with regard to the surrounding high agglomerate mountains is not suggestive of a volcanic neck, and I am rather at a loss to explain it. Its shape is very like that of the "mamelons" figured in geological text-books, but from its composition (a basic augite andesite) I think the lava would probably be too fluid to assume such a form.

The water-parting between the Waidina and Navua Rivers follows a curved line a little to the west of that joining the mountains Nairibiribi on the north and Naitabuaitui on the south. Its altitude where the track crosses it is 530 feet above sea-level (aneroid).*

The western vertical face of Nairibiribi is certainly composed of agglomerate and shows a distinct dip to the southward at 26°. The true dip appears to be greater than this and towards the east of south.

The slope from the water-parting to the bed of the Navua River is very steep. The river is struck at the point where a small tributary (Waimala) from the east enters it. This tributary rises in the neighbourhood of Nairibiribi, and its bed is choked with huge fragments of andesite agglomerate up to 40 feet in diameter. The actual bank is formed by a solid outcrop of light-coloured andesite. This is highly jointed; the main set of joints dip W.S.W. at 55°, the others being rather irregular.

The differences between the districts on opposite sides of the stream are very marked. On the eastern side are immense hills of andesite agglomerate rising for hundreds of feet in sheer precipices. To the west the country consists mainly of rather low hills of soft "soapstone"-like andesite tuffs covered with low "reeds," giving the hills a smooth appearance and a light yellowish-green colour.

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* Heights expressed thus were taken by means of a good aneroid barometer and corrected for sea-level by comparison with the official readings of the standard barometer at Suva.

A little above this point a volcanic rock of a type not met with in the Waidina valley puts in an appearance. This is a hornblende andesite with well marked hornblende prisms. The shingle in the river is coarse and is made up largely of typical diorite and quartz diorite.

The river does not very closely follow the boundary of the agglomerate hills to the east, but in a general way it may be said to do so. The banks are composed of bedded tuffs, mostly about horizontal, but often with very marked dips in various directions. The tributaries which enter the river come from the east, and contain pebbles of andesite and andesite agglomerate. Much of the tuff is full of small but perfect augite crystals.

The mountain Nabui (Plate xxvii., fig. 10) is about one mile from the river to the east. It appears with the glasses to consist of agglomerate, but this is by no means certain. Its marked columnar structure is rather suggestive of solid andesite, and its shape of a large volcanic neck. It was, for me, inaccessible, so the point had to be left undecided. A creek coming from the direction of the mountain brings down agglomerate (Plate xxix., fig. 12), solid andesite and fine tuff.

Above this point the course of the river lies amongst the rugged agglomerate hills. The boundary of these hills sweeps away in a long curve to the west of north for a considerable distance from the point where the river leaves them. The boulders which litter the stream bed are of large size, up to 4 feet in diameter, and subangular in shape, so that the plutonic rock may be *in situ* somewhere close at hand. Very possibly there is an outcrop to the west.*

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* I did not notice any considerable tributaries about this part of the river, though two are shown on the map. This is explained, perhaps, by the fact that the track cuts across one or two low spurs to avoid long bends in the river, and the vegetation is so thick that it is impossible to see more than five yards in any direction. The largest diorite boulders appear to be on the western bank.

Some distance above this point the bank of the stream shows a solid section of much jointed melaphyre, which continues for a considerable distance.

Just below the town of Qarawai there is a mass of amygdaloidal melaphyre with a decidedly greenish colour in mass. This rock contains well developed natrolite. Other outcrops of the same character can be seen on the other side of the town. These rocks and the preceding ones, which are almost certain, from lithological characters, to be lavas, have a distinctly ancient appearance as compared with any met with up to this point, except the diorite at Nasirotou. They are highly jointed, which the common andesites are not, with the exception of one at the junction of the Navua and the Waimala near Korowaiwai. They are of very different mineralogical constitution, and they are much more highly acted on by atmospheric agencies, with formation of greenish decomposition products. No actual junction was observed, but it is probable that the beautifully fresh andesites lie on a denuded surface of which these jointed lavas (?) form a part. I feel sure that they are older* than the andesites and associated rocks.

The town of Nasau is situated at the junction of the main river with an affluent, the Wainibua. The former stream comes down from the north-west, and carries boulders consisting almost entirely of quartziferous diorite, though the quartz is only interstitial. The gravels of the Wainibua also consist of quartz diorite, but the quartz is more apparent macroscopically.

At the village of Wainiveidro the quartz diorite or hornblendic granite is certainly *in situ*, though the sections are not very good. From the above-mentioned village an excursion was made to the summit of Korobasabasaga. There is no track, but we followed up one of the leading spurs to the saddle joining the southernmost and lowest of the five great summits with the next to the north.

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* The Section (Plate xxxiv.) shows that their point of outcrop is exactly on the slope joining Navunitorilau, Nadranikula, Wai ni Vadu and Nasirotou, at all of which crystalline rocks occur.

The most remarkable feature of the climb, which was very steep, was the complete absence of solid rock. Everything was rich soil, arising probably from the decomposition of the tuff, of which the mountain is largely built. Not a single outcrop, nor even a loose piece of rock, was met with all the way to within 200 feet of the saddle, where the base of a great precipice of agglomerate is seen some distance away. Another point worthy of note is the extraordinary "razor-backed" character of the ridges. Some of the leading spurs have absolutely no flattening at the top, but slope down at steep angles to great depths on either side. The main backbone of the mountain is not more than a couple of chains wide. This razor-backed character of the ridges is very marked all over the central part of the island, and testifies to the great rapidity of subaerial denudation occasioned by the torrents of rain.

The southern summit arises from the backbone of the mountain as a column, roughly elliptical in shape, some 150 to 200 feet in average diameter, and bounded by perpendicular cliffs at least 50 feet in height. The actual summit is quite another 50 feet higher. The height above sea-level of the base of the column is 3025 feet (aneroid). The rock of which this column is composed is a very coarse agglomerate. The groundmass is made up of comminuted fragments of the rock supplying the large fragments which are up to 6 feet in length. The rock is a beautiful hornblende andesite with finely developed prisms of hornblende. The cliffs bounding the ridge are apparently composed of similar rock. Time and weather did not permit of the examination of the other peaks, but their structure is certainly identical with that of the one examined, and there is no doubt that the whole mountain is a huge volcano, or rather a line of closely packed sister cones. The summits represent the consolidated fragmental materials which filled the funnels when activity ceased.

Following up the Wainibua from the village of Wainiveidro no distinct exposures of granite are met with, but the soil has all the appearance of granite soil. At a point about 2½ miles above the village a solid outcrop of the rock *in situ* is met with; it forms a bar across the stream and gives rise to a small cascade at a point called Nadranikula (Plate xxx., fig. 13). The rock is much jointed but not very much decomposed. The main joints dip E. 66° S. at 65°; E. 38° N. at 73°; N. 3° W. at 80°; and E. 10° N. at 77°.*

The rock is a moderately coarse-grained holocrystalline mass of a light grey colour. In it quartz and felspar are both very abundant. Hornblende is also largely developed, and biotite to a slightly smaller extent. Magnetite is present in normal quantity for a somewhat basic variety of granite. Under the microscope apatite and sphene also appear. The joint faces are coated with a little yellow decomposition product. This rock continues to outcrop strongly and continuously for a considerable distance. It makes rather rough country. From Nadranikula to the summit of the pass (Navunitorilau) is about four or five miles. No really solid outcrops occur for the last mile or so, but the rock undoubtedly continues, as decomposed outcrops are met with. The summit of the pass is 1290 feet above sea-level (aneroid).

From this point another excellent view of Korobasabasaga (Plate xxviii., fig. 11) and other similar mountains is obtained. The ridge of Navunitorilau forms the main divide between the Navua and Wainimala Rivers. The latter is the principal tributary of the Rewa. The northern side of the ridge is, like the southern side, composed of plutonic rocks. These for the most part are represented by quartz diorites. In places the rock, which is yellowish-white in colour, is so thickly spotted with nearly black basic secretions that one is tempted to coin the term "leopard rock" for it. The character of the outcrops in the bed of the creek which forms the track do not change materially for about five miles.

At a point about one-quarter of a mile above the village of Nasava, the track crosses an alluvial flat. No outcrops are seen for a similar distance the other side of the village, when an artificial cutting shows a marked change in the character of the rock. The rock exposed is a fine slaty quartzite of undoubted sedimentary origin. It is highly jointed; this phenomenon masks any very obvious contortions, so that in the short time available for my observations I could not trace any line of folding. For the same reason no detailed search for fossils could be made. The rock is an anything but promising one for such a purpose.

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* The direction and dip of the joints here and in other exposures is given in detail, as a comparison at some future time, when more data are available, may give some information as to direction of action of earth movements.

The joints are very regular for short distances, but do not continue to strike in the same directions in different outcrops. On the whole there is, however, a marked tendency for certain of the jointed planes to strike in a general north and south direction, though with variable dip.

These jointed quartzites continue to outcrop at intervals all the way to the large town of Narokorokoyawa, a distance of more than five miles. Many good sections are obtained as the track is a made one, traversing the spurs of the hills instead of the river bed as is usually the case. Narokorokoyawa stands on a very extensive alluvial flat just below the junction of the main stream with a large affluent coming from the east. The flat is about one mile long. After crossing it a new type of rock is met with. This is a moderately coarse-grained biotite granite, with very abundant quartz and some hornblende. No perfectly fresh specimens could be obtained, even in the road cuttings, but sufficiently undecomposed material for rock-section was procured. The petrological details of this rock will be described in Part ii. of this paper. Like all the other geologically old rocks met with, the granite is much jointed, though not to the same extent as the quartzites and quartz diorites described above. This rock again forms a persistent outcrop and extends without interruption for about 4½ miles. Within the next mile and one-half several alternations of granite and quartzite occur, but no junctions are to be seen, as these points form lines of weakness and have, therefore, given rise to valleys. The track crosses these valleys too far below their heads to allow of the relations between granite and quartzite being determined.

The quartzites outcrop strongly on the north-east bank of the river, opposite the town of Togicedra, and continue to a point a little past the town of Matainasou (altitude of river bed 300 feet [aneroid]) (Plate xxxi., fig. 14). Hence, for a distance of three miles, no solid out-crops are met with, but the very slippery nature of the path suggests soapstone-like tuffs again. Then sandy tuff is met with *in situ*.

Two miles below Udu, at the junction of the Wainimala with a large tributary, the Wailoa, there is a strong outcrop of highly jointed tuff with a well marked dip of 16° towards N. 40° E. The dip joints are about vertical. A second set dip S. 13° E. at 58° (Plate xxiv., fig. 6).

The Wailoa (transl. = Black River) receives its name on account of the material composing its bed. The rocks are mostly vesicular olivine basalt, very rich in magnetite, and the latter mineral forms the bulk of the sand. The steam holes in the lava are lined with zeolites. For about one mile above Udu the rocks consist of highly jointed, fine green tuffs of rather ancient appearance, but above this point the river enters high volcanic mountains. These are formed of basalt agglomerate, and are the source of the black gravel and magnetite sand mentioned above. They appear to extend for a considerable distance to the north and east.

Above the village of Nabuacada, 2½ miles up stream from Udu, quartz diorite again puts in an appearance, forming a rather limited outcrop on the right (western) bank of the stream. The basaltic mountains rise abruptly from the eastern bank in precipices hundreds of feet in height. Again, at several points within the next five or six miles, quartz diorite is met with here and there. It occurs in the form of large angular boulders in the beds of small streams cutting through agglomerate *in situ*. This indicates the occurrence of the diorite *in situ* at no great distance amongst the high country away to the south-west.

This is the last point on the present section where plutonic rocks appear *in situ* in large masses.

From Vuniwaiwaivula to Nubumakita the track passes over hills rising to a height of 1550 feet (aneroid) above sea-level. These hills are composed exclusively of yellowish-grey soapstone-like tuffs. Near Nubumakita (1000 feet) these tuffs dip uniformly and at gentle angles in a general north-easterly direction, and exhibit very perfect sphheroidal weathering. These tuffs have a very wide extent over this part of the island, and form the predominant feature all the way to the north coast.

At Nasoqo, nine miles (about N.W.) from Nubumakita, an interesting section is met with. About half-a-mile up the stream (head waters of the Wailoa) there is a *marine conglomerate.* No underlying rocks were observed, nor were granite or diorite boulders met with in the stream *above* the point of outcrop of the conglomerate. The latter consists of a yellowish sandy base of tuffaceous origin, containing tiny augites. Through this base are scattered rather sparsely well rounded pebbles up to four inches in diameter. *Some of these at any rate consist of quartz diorite fairly coarse in grain.* The marine origin of the formation is proved by the occurrence of shells. Unfortunately these do not appear to be numerous, and I did not find many. Amongst other shells which I did obtain is an undoubted *Conus*, but too much damaged to determine specifically. The height above sea-level of this bed is 790 feet (aneroid). It is overlain by a fairly thick bed of fine, muddy, blue-grey tuffs estimated at about 50 feet thick. A short distance back from the stream, cliffs of coarse augite andesite agglomerate rise several hundred feet in height. Huge boulders of this agglomerate are met with in the creek. The rock is dark in colour, and distinctly more basic in character than the augite andesites of the southern portion of the island, though probably not quite so basic as those near Udu mentioned above. The base is remarkable for containing, quite abundantly, fairly large and perfect augite crystals.

Cutting through the grey muddy tuff overlying the conglomerate is a dyke of basic rock. This is somewhat irregular in shape and direction, as might be expected from the softness of the intruded rock, but its occurrence is important as giving some idea of the age of the volcanic rock in this area. This Nasoqo section is one of great interest.*

On the western slopes of Tama ni Ivi, the highest mountain in Viti Levu (4555 feet, Admiralty chart), a type of volcanic rock is met with different from anything observed up to this point. The rock in question is rather light bluish-grey in colour, but is shown by the microscope to be comparatively basic in character. It may be termed an andesitic olivine dolerite. The olivine, though not very abundant, is quite an important constituent.

Tama ni Ivi consists very largely of tuffs associated with flows of lavas of the type just described. The mountain, therefore, probably represents an old volcanic centre, but differs from those to the south, of which Korobasabasaga (p. 472) may be taken as a type, in having an inconspicuous summit, and not being composed to any very noticeable extent of agglomerate. At Nadarivatu, distant about five miles in a direct line from the north coast of the island, still more basic rock occurs. It is dark in colour, and contains large idiomorphic crystals of augite, and comparatively numerous, though not large, olivines. It is a typical andesitic olivine dolerite. This rock forms a very extensive sheet, reaching for miles away to the west, and forming a very marked and precipitous scarp about 2000 feet in height. What its geological relations are I was unable to determine. From the foot of this scarp the land forms a comparatively even low-lying plain to the sea. This plain is dotted with conical hills whose form is exceedingly suggestive of partially ruined tuff-cones. Where sections are obtainable, tuffs are exposed whose dips run at comparatively high angles (up to as much as 34°), and are very variable in direction. These facts seem in favour of the theory that the small coastal hills are largely craters. In one case there is apparently evidence of an extinct hot spring or solfatara.

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* NOTE.—The natives informed me that "laselase" occurs somewhere in the neighbourhood. This term is applied to almost any rather soft white rock, and may indicate that raised reefs occur there. I was unable to investigate this further.

The basaltic rock is leached out and bleached to a kind of compact "bathbrick." This bleached material forms a sort of crater, but there is no native tradition of any solfataric or hot spring action. Close to the base of the mound on which this occurs, there is a good deal of broken-up milky, crystalline quartz. I was unable to determine its origin. A second hill, rather larger than this one, and distant about a mile from it, is said by the natives to consist of decomposed and bleached rock similar to that described above. For the last two miles to Tavua the road passes over the alluvials of the Tavua River to its mouth, thus completing the first section across the island from south to north. It is possible that the whole of this coastal strip may represent a subsidence area, and that the steep scarp which bounds it to the southwards may be due to an east and west fault.

2. *From Nadarivatu to Vatukarasa (South Coast).*

The return section from north to south was even more interfered with by adverse meteorological conditions than the first traverse. Starting from Nadarivatu, the road following one of the branches of the Sigatoka River traverses fine to medium tuffs. Over wide areas these are practically horizontally bedded. Very numerous small and large volcanic cones, all more or less denuded, are dotted amongst these tuffs. Where vents occur, lava streams and plugs are developed, and the associated tuff beds dip at high angles. The dips constantly change in direction.

In some places, *e.g.*, at Nadrau, the lava sheets attain a great thickness, probably in the neighbourhood of a specially large vent. In the case mentioned, very marked prismatic structure is developed, but at other points the lava is vesicular and, in some cases, quite pumiceous (Plate xxxii., fig. 15).

The rock is everywhere a typical basic augite andesite. The tuffs are light in colour, and, as already stated, medium to fine in grain, and so friable that few of them carry well. The finest of them exhibit small spheroidal weathering. The coarser ones are very remarkable for containing abundant ideally perfect crystals of augite varying from submicroscopic individuals up to half an inch in length.

With the exception of the highly inclined members, which form part of actual cones, it is probable that most of the tuffs are submarine in origin. The uniform gentle dip (about N.W. at 9°) over wide areas is difficult to explain on any other hypothesis. Actual evidence is available at Nadrau where the tuff underlying the columnar andesite contains numerous shell fragments. I was unable to obtain any perfect specimens, but found one recognisable ear of a Pecten. A large fragment of coral, *Goniastræa* sp., was also found imbedded in the tuff at an elevation of 1290 feet (aneroid) above sea-level.

Coarse agglomerates, similar to those met with so abundantly in the first traverse, are not at all extensively developed in this region. A great belt extends from Nadrau for some miles southwards, but they do not form anything like so marked a feature as they do in the eastern portion of the island.

Some distance north of Waisa there is what appears to be a dyke of andesite 20 feet wide, cut through the tuffs. This dyke (?) is not straight, but forms about a quadrant of a circle whose chord is about east and west. The diameter of the circle is about half a mile.

From this point to the large town of Waisa the tuff beds are again fine-grained, and almost level, the general dip being about N.N.E. at 3° to 7°. Just north of the town (Waisa) there is a patch of tuffaceous conglomerate containing rounded boulders of andesite (Plate xxxii., fig. 16).

South of the town the character of the country changes. The place of the friable, level, and recent-looking tuffs is taken by hard greenish-looking tuffs, highly jointed and with obscure dips at high angles. These give place here and there to the recent soft tuffs.

About six miles south of Waisa, an affluent called the Nakabi enters the Sigatoka from the east. Amongst the gravels are a few well-worn pebbles of granite, but from the fineness of most of the material and the comparative scarcity of pebbles, it is evident that the soft tuffs of the immediate vicinity must extend a long way to the east.

Half a mile further south is the town of Nalaba. Just before reaching the town itself the path leads round a point composed of finely jointed slate. Bedding planes are obscure, but the jointing is highly perfect, though somewhat curved and irregular.

The tributary just mentioned flows from the general direction of the old rocks described in the first traverse, and indicates that plutonic rocks must exist between the quartzites of Narokorokoyawa and the slates of Nalaba. If the line so obtained indicates the axis of the ancient continental area, it will be seen to run approximately east and west.

To the west the character of the country indicates a continuation of the hard ancient-looking tuffs for about two miles south. To the south-east the rocks are mainly soft tuff. After passing the hard rocks just mentioned the country is mainly built of soft tuffs all the way to Natuatuacoko. These form steep but rounded, grassy hills. These are intersected here and there by dykes.

About five miles below Nalaba, at the village of Waibasaga, another group of hot springs occurs. Of these, I was able to visit only one. This rises in a hole in soft alluvial soil with no rock outcrop. The temperature is intermediate between those at Naseuvou, being just too hot to keep one's hand immersed. There is no deposit nor vegetable matter, but gas bubbles rise fairly freely. There is a faint odour of H_2S. A cold tributary of the main river flows within fifty yards of the spring. A second spring is situated about half a mile from the first. From native accounts the temperature must be considerably lower than that of the one visited.

On the day after my arrival at Natuatuacoko I paid a hurried visit to some caves on the other side of the river. I could spend only a very short time there, as the ford was rapidly becoming impassable. The caves are situated in a bed of very tuffaceous limestone about 200 feet in thickness. This is covered by a bed of fine soapstone-like tuff forming a conical hill with very steep sides. The summit of this hill is flat, and is formed by the last small patch of a bed of limestone 5 feet in thickness, containing numerous corals. This bed has an altitude of 510 feet (aneroid) above sea-level.

From Natuatuacoko to Lebaleba, the head of canoe-navigation of the river, there are reddish soapstone-like tuffs with steep dips, probably due to folding.

From the latter town to Rarayaka the journey was accomplished in a canoe on the heavily flooded river, so that geological observations were out of the question. With the exception of a patch near Qalimari, the rocks are all tuffs, coarse and fine. In parts the bedding appears extraordinarily twisted, and in some cases seems to be overfolded to form loops. This may possibly be spheroidal weathering, but, if so, the scale on which it occurs must be enormous, some of the loops being fully 30 to 40 feet in diameter.

For several miles in the neighbourhood of Qalimari the eastern bank is formed by cliffs of hard white limestone, rising to a height of over 1000 feet above the river. In places, at any rate, this is highly silicified, as chalcedonic nodules are numerous. A chemical analysis of a portion of it, made at the Adelaide University, shows that it is on the whole an exceedingly pure limestone, so that the silica must be very local. No dip could be observed from the river. Andrews (p. 13 of his Report) has described these limestones as dolomites, which they certainly resemble very strikingly. Analysis shows that they contain about 98% $CaCO_3$. Andrews regards them as older than the upraised reefs of the Cuvu-Sigatoka area.

From Rarayaka to the coast at Vatukarasa the rocks are all tuffs, agglomerates, and lavas. Along the coast the section was not continued on account of very bad weather. The collections made from Rarayaka onwards were unfortunately lost. They contained some very remarkable, bright green, hard tuff from the south coast.

VI.—SUMMARY OF RESULTS.

The general results may be summarised as follows:—

For the most part the coastal portions of the island are composed of redistributed tuff (soapstone), interstratified here and there with calcareous formations of comparatively recent geological age, or else of geologically young lavas, tuffs, and agglomerates. These latter also extend throughout the high lands of the interior. At various points in the valleys of the interior there are isolated and, also in some cases, fairly extensive continuous outcrops of rocks enormously older than any of the above. Though such rocks were met with *in situ* only in comparatively few localities, their distribution must be very wide, as is indicated by their almost universal occurrence in the river gravels. These facts point to the existence of a general platform of ancient rocks on the surface of which are built up innumerable volcanic cones, whose products as a rule overlap and effectually conceal the underlying rocks. If these older rocks consisted only of plutonic rocks, it might possibly be argued that they represent the deep-seated portions of volcanic mountains which have been so extensively denuded as to have their very bases laid bare, in this way bringing to light the magma which has solidified there under plutonic conditions. That this is not the case is proved by the fact that rocks of undoubtedly sedimentary origin, viz., quartzites and slates, also occur, in association with the plutonic rocks. In addition to these, and closely associated with them, there are abundant rocks of volcanic origin whose lithological features indicate that they are of great age. In every character they appear immensely older than the universal andesites. They have undergone extensive molecular rearrangement (showing traces of foliation with development of such minerals as epidote) and decomposition, and are highly jointed, while the comparatively recent tuffs lie uncomformably over them.

It, therefore, appears that the geological formations of Viti Levu are divisible into two main groups. The first of these includes continental rocks of high but undetermined geological antiquity. The second includes Tertiary to Recent formations of volcanic and sedimentary origin. Between these there is an enormous hiatus.

So far as I have been able to ascertain, rocks characteristic of continental areas have nowhere been met with so far removed from large land masses. It seems probable, nevertheless, that Fiji forms part of an exceedingly ancient continental land mass. An argument against this theory is the fact that great ocean depths are met with between it and the nearest undoubted continental masses to the west, New Caledonia, and to the south, New Zealand. This difficulty is not, however, insuperable. That it is quite possible for an outlier of a continent to be separated from its parent mass by deep ocean is proved by the case of Madagascar. This island, which is undoubtedly an outlier of South Africa, has been separated from the mainland by extensive "Senkungsfelde" which have produced the Mosambique Channel. This channel is quite as deep, though not quite so broad, as the sea which separates Fiji from New Caledonia.

In the case of Madagascar, however, there is distinct evidence of extensive faulting on both sides of the channel, and again to the eastwards. Such a faulting has not been directly proved in the case of Fiji.

A considerable thickness of Eocene beds has been deposited on the flanks of Madagascar and the opposite coast of Africa. If this series is continuous across the strait, it may very considerably lessen the depth of water. Between Fiji and New Caledonia such deposits would not be likely to occur to any great extent owing to the absence of large land masses from which sediment could be derived.

The age of the separation of Madagascar from Africa is determinable between moderately narrow limits, but this is not at present the case in Fiji.

The area must probably have been below sea-level during early geological time for the deposition of the material of the quartzites of Nasava and the slates of Nalaba, if these are marine in origin. How long this condition lasted it is impossible to determine. Then came an extensive elevation by which the formations were brought above sea-level, plicated, metamorphosed, and weathered. This period, too, must have extended over an enormous time during which the land was denuded to its very roots so that plutonic masses of granite and quartz diorite were laid bare. Most of the sedimentary formations were completely swept away. Then probably followed the separation of the outlier from the main continent. An extensive subsidence of the Fijian area to the extent of at least 1300 feet then took place, as is proved by the occurrence of fossiliferous tuffs at Drau (1290 feet) and Nosoqo (800 feet). At the latter place the shells are associated with a tuffaceous conglomerate containing large water-worn granite pebbles (up to 4 inches in diameter), and therefore probably of the nature of a basal (?) conglomerate. Since then there has been an oscillation in the sea-level, but on the whole with a tendency towards positive motion of the land. Andrews has shown that this elevation is very marked in the islands of the Lau Group, viz., Cikobia-i-ra 630 ft., Tuvuca 800 ft., Vatu Vara 1050 ft., and Yacata 840 ft. In the Yasawas an elevation of 800 feet is recorded.

vii.—COMPARISONS AND CONCLUSIONS.

From the fact that rocks such as granite, diorite, and other plutonic eruptive rocks, and sedimentary formations such as schists and slates occur, with few exceptions, only on continents or on islands whose geological connection with continents is obvious, the theory of the "Permanence of Ocean Basins and Continental Areas" has arisen. This theory is still further supported by the fact that, with a few exceptions, islands rising from great ocean depths are composed of volcanic rock, organically formed limestone, or a mixture of the two, like Christmas Island in the Indian Ocean.

The special interest which attaches to the geology of Fiji arises from the fact that it is one of the most marked, if not the most marked, exception to the rule above stated. Of the neighbouring islands to the east, Eua in the Tonga group is the only one where any trace of plutonic rock has been discovered, and here it was only in the form of inclusions of fragments of red garnet, tourmaline, and "uralitized gabbro" as already described (p. 461) floated up in lava, probably from great depths.

To the west the case is different. On several islands of the New Hebrides group continental rocks have been found. Comparatively little is known of their occurrence, but at Malicolo* and Spiritu Santo gneiss and crystalline limestone have been found, and at Aneityum serpentines like those of New Caledonia.

The continental origin of the latter island is undoubted, containing, as it does, extensive areas of gneiss and various schists, sedimentary formations containing Palæozoic or Mesozoic coal, and serpentines and peridotites.

The Solomon Islands, according to Guppy,† contain extensive areas of quartzites and schists. Thanks to the kindness of Mr. Milner Stephen, of the Pacific Island Trading Co., Ltd., I have been able to examine a small collection of pebbles from the Solomon Islands. These were collected by agents of the above Company, mainly, I believe, from the gravels of the rivers. The most important specimen was a very small one of coarse hornblendic gneiss from Thousand Ships Bay in Vulavu. Others were limestone, recalling the Qali Mari limestone of Fiji, from Guadalcanar and Ysabel; jasper from Guadalcanar and Vulavu, and green tuff from Vulavu.

New Guinea, Borneo, Java, Sumatra, and in fact all the larger islands comprising the great archipelago stretching from Australia to Asia are built up largely of rocks of undoubtedly continental origin.

To the south of the Fiji group lie Norfolk Island, Lord Howe Island and New Zealand. The two small islands do not contain continental rocks.

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* Levat, D., in Imhaus E.N. "Les Nouvelles Hébrides," Paris-Nancy, 1890, pp. 122-127.

† Guppy, "The Solomon Islands, their Geology, General Features," Lond., 1887.

New Zealand may almost be regarded as a continental area by itself, since, according to Hutton,* "sedimentary rocks are represented of nearly all ages, from Archæan upwards, and all but the lowest have yielded fossils, in some places abundantly. . . . Metamorphic and eruptive rocks of nearly all kinds."

If we compare the region under consideration with others in the world, we meet with certain marked points of similarity, but at the same time the south-western area of the Pacific is unique in many of its characteristics.

One of the areas which may be mentioned for comparison is the gap between North and South America, with its included islands. Of the West Indian Islands practically all the larger ones contain continental rocks. In the Lesser Antilles, according to Spencer,† no ancient rocks come to the surface. Trinidad is different, its relationships being distinctly continental. The channel which separates it from the mainland of South America is only 36 feet deep. Continental rocks appear in the island. They are represented by crystalline schists, sandstones, shales, &c., along the northern side of the island. The shallow submarine plateau, upon which Trinidad stands, runs northwards towards the chain of the Lesser Antilles, and round by way of the Greater Antilles to the middle part of the Central American Isthmus and also to Florida. It forms an almost continuous ridge crossed in places by deep furrows, but nowhere as much as 1000 fathoms in depth. Enclosed by this submarine plateau are three large areas of deeper water, the largest of which is the Carribbean Sea, with depths ranging over 2000 fathoms.

In the case of Madagascar we have another very interesting comparison. The island forms an undoubted outlier of the African Continent. According to Suess‡ it is built up of a core of heavily faulted crystalline rocks, upon the flanks of which marine sediments of Mesozoic and Eocene age have been laid to a considerable thickness. The Mozambique Channel forms an immense "Senkungsfeld," a huge slice of the earth's crust which has been let down by a series of trough faults. On the island of Madagascar the aggregate throw of these faults on the eastern side of the island amounts to 1200 meters. Marine strata of Cretaceous age have been let down by the faulting, proving that the crustal movements are Post-Mesozoic in age.

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* Q.J.G.S. xli. (1885), p. 191.

† "On the Geological and Physical Development of Dominica," &c. Q.J.G.S. lviii. (1902), p. 341. And "On the Geological and Physical Development of Barbadoes," &c. *Ibid.* p. 345.

‡ "Das Antlitz der Erde." Vol. i. p. 531, *et seq.*

In the case of the South-Western Pacific area, we have several points in contrast to those mentioned above. In the first place, the distances between the islands are much greater than in the West Indian area, and the intervening depths are very considerable. In the second place, the existing land masses are very insignificant when compared with the bulk of Madagascar.

The first consideration is, to my mind, the more serious, involving as it does the question of the permanence of the ocean basin in the area to the west of Fiji.

It has been suggested that the occurrence of granites and other plutonic rock in Fiji might be explainable on other than a continental hypothesis, by regarding them as having been injected during late geological time into a mass of volcanic material built up from the floor of the deep ocean; an ordinary oceanic island, in fact. This leaves out of consideration the extensive quartzites which occur on the island.

The evidence as to the age of the granites is also fairly conclusive. On lithological grounds, the age of the rocks in question seems to be great. They are so intensely jointed, and show so many evidences of great earth-movement. Of course, strain-structures do not necessarily indicate very high geological antiquity, as is evident from the occurrence of Mesozoic schists in the Alps. In the latter case, however, we have to deal with an area where great folding has taken place in late geological time, and, at present, we have nothing to justify the supposition that intense orogenic processes have been going on in the Fijian area.

Still more conclusive evidence of the age of the granites is afforded by the section at Nasoqo. Here, at a point of over 800 feet above sea-level, there is a tuffaceous *conglomerate containing well worn pebbles of granite associated with Tertiary fossils.* This proves conclusively that the granite must be at any rate Pre-Tertiary, and probably much older. This fact is of extreme importance.

As already stated, the great objection to the continental theory is the depth and extent of the ocean between Fiji and the nearest considerable area of continental land. This objection is to a certain extent answered by the fact that there are numerous instances in which the earth's crust can be proved to have undergone movements sufficient to account for the great depth of water.

In the case of the great Uinta Fold of Colorado, White* estimates the total vertical displacement at 28,000 feet.

In the case of Madagascar, above cited, the Mozambique Channel, with a depth in parts of over 2000 fathoms, has been proved to be the result of a series of trough faults.

The Great Rift Valley of Africa may be taken as still another instance of a slice of country which has been let down by a series of parallel faults, the aggregate displacement being 4000 to 5000 feet.

Coming nearer home, the great coal basin under Sydney affords a magnificent instance of the flexibility of the earth's crust. According to the section given by Professor David,† the subsidence in this area amounts to at least 7000 to 8000 feet.

In the South Wales Coalfield there is a series of fresh water coal-bearing strata which reach a maximum depth of 12,000 feet. As these strata were formed at the earth's surface, we have here evidence of a depression amounting to 2000 fathoms.

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* White, C. A., "On the Geology and Physiography of North-Western Colorado and adjacent parts of Utah and Wyoming." Ann. Rep. U.S. Geol. Survey, ix., p. 696.

† Pres. Address, Journ. Roy. Soc. N.S.W., xxx., 1896.

In the German Coalfield the thickness of the coal measures is given by Geikie as 20,000 feet.

These instances serve to show that movements of the earth's crust have taken place, quite sufficient in magnitude to account for the total depth of ocean between Fiji and New Caledonia or New Zealand.

Assuming that the continental origin of Viti Levu may be regarded as proved, it remains to point out what are its relations to the adjacent continental areas, the cause of its severance from them, and the time at which a separation took place. These questions cannot be answered satisfactorily at present. So far as I am able to ascertain, the rocks collected by me do not exhibit a marked similarity to those of either New Zealand or New Caledonia.

According to Suess,* (on the authority of Hutton, *loc. cit.*, for New Zealand) two axes of folding can be traced in each area. In both cases the axis of the most ancient rocks is N.E. and S.W. In the case of New Caledonia, a N.E. line will pass very close to Fiji. The axis of folding in Viti Levu cannot be determined with the data at present available, as the number of observations on jointing is insufficient. I have the information upon hearsay that the rocks of Vanua Levu are similar to those of the larger island, and from the relationship between the two land masses this is more than probable. If, then, the general trend of Viti Levu and Vanua Levu represent roughly the axis of folding of the ancient rocks, the latter must run in a general E.N.E. and W.S.W. direction, and, therefore, more or less in the same direction as that in New Caledonia. Though this evidence is rather slender, it is by no means improbable that future investigations will show that Fiji is structurally connected with New Caledonia.

When we come to consider the question of the method of separation of the two land masses, two hypotheses are possible. Either the intervening area has been dropped bodily by a series of faults, as in the formation of the Mozambique Channel, or may have formed a wide synclinal fold without dislocation.

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* Q.J.G.S. xli., p. 191 *et seq.*

In the case of Madagascar, definite faults have been traced and measured. That no such faults have been observed in Fiji does not definitely prove that they do not exist. It is quite possible that if great faults have been formed, denudation and cutting back of the coast line may have completely hidden their traces. Additional detailed work may reveal their existence.

As stated above in the Summary of Results, there is reason to believe that Viti Levu consists of a core of very ancient, perhaps Archæan rock, surrounded and partially covered by marine deposits of Tertiary and Recent Age, and Cainozoic lavas. So far, no traces of Palæozoic or Mesozoic formations have been observed.

This structure may be explained in various ways. The area may have been one of prolonged and continuous subsidence since very early geological time. It is conceivable that all the geological formations from Cambrian to Tertiary may have been deposited in orderly sequence upon a basis of Archæan rocks which were slowly sinking.

If such an event were to happen, denudation would be constantly reducing the bulk of the ancient continent, whose borders would also shrink as it became submerged. For these reasons the amount of material entering into the composition of each formation will be constantly on the decrease, and the tendency would be *not* to fill up the sea with sedimentary deposits so as to keep it approximately the same depth throughout, but to have an ocean becoming constantly deeper as time went on. Abundant evidence has been brought forward to prove that an elevation amounting to at least 1290 feet in Viti Levu, viz., at Drau, and as much as 1050 feet at Vatu Vara has taken place since Tertiary time. This elevation would not be sufficient to bring to light the older formations.

It is very unlikely that such a movement would be continuous. It would no doubt be oscillatory, but with the general tendency towards depression of the land, and the nett result a considerable subsidence.

An alternative hypothesis is that the area may have been one of continual elevation, denudation about keeping pace with the uplift. In this way various marine formations would be laid down throughout geological time, but as quickly as they were raised above sea-level they were denuded and so no trace of them left. Then a subsidence took place early in Tertiary time which permitted the formation of the various marine Tertiaries. Within recent times uplifts have taken place as indicated above.

A third explanation is the one accepted by Wichmann (20), namely, that after the formation of the sediments of Pre-Cambrian or very early Palæozoic age, the area became a land-surface and remained so during the whole of Palæozoic and Mesozoic time. Then a subsidence permitted the deposition of the Tertiaries, and the final uplift followed as above indicated.

Any of these hypotheses explains reasonably the structure as we now find it, but there are certain objections in each case.

To my mind, the first theory is the most probable, namely, that the area has, on the whole, been one of prolonged subsidence. That we should have such a continuous subsidence as this idea calls for, is certainly somewhat difficult to account for.

In most cases with which I am familiar, where a prolonged subsidence has taken place, it has not, at most, lasted for more than three or four geological periods without very strong uplifts.

If, however, we accept the great principle which underlies the theory of the permanence of ocean basins, namely, that the general tendency is for the ocean basins and the continental areas to become more marked—that is, for the oceans to become deeper and the continents higher with increasing age—the difficulty, to a great extent at any rate, vanishes, as we have to deal with an area lying between the great oceanic area and the great continental mass, but rather towards the former than towards the latter.

In the case of the second theory, we are met by several objections. If the area has been one of average continuous elevation it should be one of continuous peripheral growth, but such does not appear to be the case.

Again, even taking into account the very rapid degradation which must go on under the heavy rainfall of the tropics, it is improbable that the Palæozoic and Mesozoic strata would be so completely removed as to leave no trace of their former existence. We should expect, at least, to find traces of them as *pebbles in the conglomerates, but this is not the case, though, as we have seen, pebbles of the older rocks are met with.*

If the area had been a stable land surface for an enormous period of time, as suggested by Wichmann, there should be a continental shelf of vast size, but the contour of the ocean floor does not appear to afford evidence of one at all comparable with what we should expect.

On the other hand, the subsidence theory accounts completely for the entire absence of Mesozoic and Palæozoic formations, for the very small size of the land area, and for the depth of the ocean in its vicinity. If this theory be the correct one, we are forced to the conclusion that the final separation of Fiji from the Austral-Papuan Continent must have taken place at an extremely remote date.

It thus appears that the geological evidence is entirely in accord with that derived from biological observations, of which a brief summary has been given (p. 458). For a fuller *résumé* of the biological evidence, see the papers by Hedley, Ortmann, and others. These will show that all the evidence so far collected tends towards the same conclusion, but they also indicate what a vast amount still remains to be done in the field of biological as well as geological research in this most interesting and important region. The work lies at our door, and it is for the scientific workers of Australia to throw light on those points which are still shrouded in darkness.

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EXPLANATION OF PLATES.

Plate xxii.

Fig. 1.—Raised Reef (in which *Carcharodon* teeth (fig. 3) occur) capped by "Soapstone"; Walu Bay, Suva.

Fig. 2.—Conglomerate Bed at Base of raised Reef, Walu Bay.

Plate xxiii.

Fig. 3.—*Carcharodon* tooth from raised Reef.

Fig. 4.—The Great Dyke of Devo near Nasirotou, Lower Waidina River. The view shows the western face considerably foreshortened.

Plate xxiv.

Fig. 5.—Buki Levu from the south. The photograph brings out the difference in shape and vegetation between portions of the country composed of hard Volcanic Agglomerate (the high hills to the left), and other portions composed of "Soapstone" (the undulating country to the right).

Fig. 6.—Jointed Tuffs; Wailoa River above Udu.

Plates xxv.-xxvi.

Figs. 7-8.—Panoramic View of Range of Volcanic Mountains on Upper Waidina, Voma on the extreme left hand. Only the western flanks of Voma appear in the picture, as the third Plate, a direct view of that mountain, was a failure.

Plate xxvii.

Fig. 9.—Namulowai, a thimble-shaped Mountain about 250 feet high; Upper Waidina.

Fig. 10.—Nabui, a high Volcanic Mountain on the Navua River.

Plate xxviii.

Fig. 11.—Korobasabasaga from the Pass of Navunitorilau. The Mountain in the distance with the steep face is Nabui (fig. 10).

Plate xxix.

Fig. 12.—Huge Boulders of coarse Volcanic Agglomerate, Navua River, illustrating both the Character of the Agglomerates, and the wonderful Transporting Power of the Streams. The smaller Boulders, on which the man in the centre is standing, are Diorite. This point is 10 or 12 miles at least below Wainiveidro.

Plate xxx.

Fig. 13.—Quartz Diorite *in situ*; near the Head of the Wainibua (just above Nadranikula). Rocks in foreground show jointing.

Plate xxxi.

Fig. 14.—Quartzites and Slates, Wainimala River at Togicedra.

Plate xxxii.

Fig. 15.—Prismatic Andesite; Drau, Upper Sigatoka River.

Fig. 16.—Level-bedded Marine Tuffs; Bua Levu, above Waisa, Upper Sigatoka River; about 1000 feet above sea-level.

Plate xxxiii.

Geological Sketch Map of Part of Viti Levu. The Topography of the Map is only approximately correct and, in some instances, is certainly wrong. The boundaries of the various Geological Formations are only roughly shown.

Plate xxxiv.

Geological Section of Viti Levu along the lines A B, C D, E F. The Section is highly generalised, and represents the ideal structure of the country.

NOTES AND EXHIBITS.

Mr. J. J. Walker exhibited well-preserved specimens of *Anaspides* (*Anaspis*) *tasmanica*, Thomson, a fresh-water shrimp found in creeks and pools on Mount Wellington, Tasmania, and adjacent mountains, at an elevation of 4,000 feet. Also as bearing upon the question of the affinities of *Euschemon rafflesia*, discussed at the April Meeting, Mr. Walker called attention to Sir George Hampson's account of a second member of the Family *Euschemonidæ* from Zululand, in Part i. of the Trans. Ent. Soc. Lond. for 1903, received by a recent mail.

Mr. Froggatt showed a fine series comprising examples of all the known species of the Neuropterous genus *Psychopsis*, in illustration of his paper.

Mr. Turner exhibited more than 100 species of plants from the Darling country in illustration of his paper. Also portions of shrubs of about a dozen western species raised from seed and now well established in Hyde Park. On the motion of Dr. Norton a vote of thanks was accorded to Mr. Turner for his interesting paper.

The Rev. W. W. Watts called attention to Mr. E. S. Salmon's successful effort [Britten's Journal of Botany, January, 1903] to unravel nomenclatural intricacies in the case of the moss described by Schwaegrichen in 1842 under the name *Barbula mnioides*, but which must now be transferred to the genus *Calyptopogon*. In Part i. of the 'Census Muscorum Australiensium,' *B. mnioides* is not recognised; but, under *Tortula*, both the species *crispata* and *Wilhelmii* are retained. In future these two must apparently be merged in *Calyptopogon mnioides* (Schwgr.), Broth. In his 'Bryales,' Brotherus gives all the species reviewed by Mr. Salmon, viz., *C. mnioides* (Schwgr.), *crispatulus* (C.M.), *Hookeri* (R.Br.), *crispatus* (Hpe.), and *Wilhelmii* (C.M.). But he partially anticipates Mr. Salmon's conclusions by saying that all these species were closely related to *C. mnioides*, and would probably, when fuller material came to hand, be referred to that species.

He also submitted for record the following list of twenty-seven Lichens from determinations by Dr. Bouly de Lesdain of Dunkerque :—

Cladonia bacillaris, Nyl.; Emu Plains, Nov., 1900.
,, *cervicornis*, Floerke; Richmond River, Aug., 1900.
,, *degenerans*, Floerke, var.; Maitland, Dec., 1900.
,, *elegantula*, Müll. Arg.; Emu Plains, Nov., 1900.
,, *enantia*, Nyl.; Richmond River, Aug., 1900.
,, *furcata*, var. *pinnata*, Wainio; Richmond River, Aug., 1900.
,, *pityrea*, Fr., var.; Richmond River, May, 1901.
,, *subcariosa*, Nyl.; Newcastle, Dec., 1900.
Leptogium tremelloides, var. *azureum*, Nyl.; Richmond River, 1900.
Parmelia caperata, Ach.; Richmond River, July, 1900.
,, *cetrata*, Ach.; loc. ?.
,, *conspersa*, Ach.; Richmond R., 1900; Goulburn, 1901.
,, ,, var.; Richmond R., 1900; Goulburn, 1901
,, ,, a form very special, approaching the var. *strigosa*, Müll. Arg.; Rocky Hill, Goulburn, March, 1901.
Physcia chrysophthalma; Hinton and Goulburn, 1900-1901.
,, ,, var. *fornicata*, Müll. Arg. (*Xantheria parietina*, v. var. *spinulosa*, Müll. Arg. olim).
Ramalina calicaris (a little doubtful); Richmond River, Aug., 1900.
,, *fraxinea*; E. Maitland, Dec., 1900.
Ricasolia coriacea, Nyl.; Richmond River, Aug., 1900.
Sticta Colensoi, Babingt.; Richmond River, 1900 and 1901.
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Usnea ceratina, Ach.; Richmond River, Oct., 1900.
,, *dasypaga*, Ach.; loc. ?
,, *dichotoma*, Fr. (?); Richmond River, July, 1900.
,, *hirta*; Richmond River, July, 1900.
,, *longissima* (?); Richmond River, Aug., 1900.
,, *poliothrix*, Kremph.; E. Maitland, Dec., 1900.
,, *trichodea*, Ach.; Richmond River, May, 1900.

Mr. Watts also exhibited a collection of North American ferns, including some rare and beautiful forms.

WEDNESDAY, JULY 20TH, 1903.

The Ordinary Monthly Meeting of the Society was held in the Linnean Hall, Ithaca Road, Elizabeth Bay, on Wednesday evening, July 29th, 1903.

Dr. T. Storie Dixson, President, in the Chair.

The Donations and Exchanges received since the previous Monthly Meeting, amounting to 19 Vols., 70 Parts or Nos., 5 Bulletins, 7 Pamphlets, 3 Miscellanea, and 1 Map, received from 49 Societies, &c., and 1 Individual, were laid upon the table.

THE CONTINENTAL ORIGIN OF FIJI.

By W. G. Woolnough, B.Sc., F.G.S.

Part II.

Petrographical Descriptions of Typical Rocks.

(Plates xxxv.-xxxvi.)

Synopsis.

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Granite (Narokorokoyawa)	501
Quartz Diorite (Nadranikula, Wainibua)	506
Diorite (Navua River at Nakorowaiwai)	510
Quartzite (Togicedra)	514
Augite Andesite (Namulowai)	515
Pyroxene Andesite (Voma, Upper Waidina River) ...	520
Hornblende Andesite (Buki Levu)	525
Hornblende Andesite (Korobasabasaga)...	529
Olivine-bearing Andesite (Tama ni Ivi, Mt. Victoria)	533
Porphyritic Basalt (Nadarivatu)	536

In the first part of this paper a sketch of the geological structure of Viti Levu has been given, and reasons advanced to prove the theory that this portion of the Fiji Group is not a typical oceanic island, but a remnant of the great Australian-Papuan Continent which in former geological time must have had a considerable extension to the eastwards of its present boundaries.

In this portion of the paper certain of the rocks collected are petrographically described in considerable detail. I have described thus only a very small part of my collections, but I have selected those rocks which are typical. I very much regret that the work must be regarded as incomplete from the absence of chemical analyses. I have been so situated that I have been unable to make these myself, or to have them made for me. The one which does appear was made by Mr. D. Mawson, B.E., and Mr. Stoddard at the Sydney University, by kind permission of Professor Liversidge, and with the assistance of Mr. Schofield, A.R.S.M., F.C.S., and to all these gentlemen my best thanks are due and are hereby gratefully rendered.

Throughout the greater part of the investigation I have been hampered by lack of a suitable microscope and accessory apparatus, as the laboratory of the University of Adelaide is only in its infancy. This and the fact that illness and the great amount of routine work in arranging the curriculum in what is practically a new course at the above University have made great demands upon my time, must be my excuse for any gaps which occur in the work. I trust that those which do occur will not seriously interfere with the accuracy or completeness of the descriptions.

Granite (Narokorokoyawa). Plate xxxv., fig. 1.

Macroscopic characters.—Specific gravity 2·66. The rock is moderately coarse in grain, and consists of a holocrystalline mass of clear quartz, milky-white striated felspar, black biotite, and dull black grains of hornblende, with a little magnetite here and there.

As a whole the rock has undergone a considerable amount of alteration, both from crushing and from chemical change. It was very difficult to obtain material sufficiently undecomposed for the preparation of thin sections, even though a considerable amount of blasting has been done in the making of a road.

The mechanical strain to which the rock mass has been subjected is expressed by the strong development of cleavage planes, etc. In the field an obscure foliation is apparent, but it is not at all marked in hand specimens.

Microscopic characters.—In thin section the rock is seen to possess a typical hypidiomorphic granular texture of rather coarse grain. The pressure to which the rock has been subjected is expressed microscopically by the shattering of the component minerals, and by the development of optical anomalies. These effects will be more fully noted as the component minerals are described in detail.

Quartz is fairly abundant in large grains, in some cases intergrown with one another. These have roughly parallel cracks running through them and passing without interruption from one grain to another, thus repeating on a microscopic scale the macroscopic jointing of the rock. *Breaking up of grains into a mosaic* is very marked. In some cases this affects the whole grain, but usually it gives rise to a peripheral zone only, surrounding an unbroken nucleus. Even where the grains are not shattered, the heavy mechanical strains they have undergone are evidenced by undulose and shadowy extinction in parallel polarised light, and by breaking up of the black cross in convergent light.

Unindividualised inclusions are abundant, both gas and liquid. The latter frequently show bubbles which exhibit spontaneous movement. The arrangement of these inclusions in lines is not very marked.

Felspar is the most abundant constituent of the rock. It is, on the whole, fairly fresh, though incipient decomposition is noticeable, and the formation of kaolin has sometimes proceeded to a considerable extent. A little of the felspar must be referred to orthoclase. It is untwinned, and has a refractive index lower than that of quartz and the dominant felspar. It occurs in perfectly granular individuals of small size, scattered through the rock, and is with difficulty distinguished from quartz. By far the greater part of the felspar is plagioclase. It occurs in subidiomorphic to granular individuals averaging about 2·5 mm. in length. These have suffered considerable mechanical deformation, resulting in bending and faulting of the twin lamellæ. The cleavages appear as sharply defined cracks which the crushing has rendered very numerous.

In polarised light the very fine lamellæ, twinned after the albite law, are *practically universal*. *Following* the absence of twinning in the orthoclase, Carlsbad twinning is very much rarer than usual. Lamellæ, following the pericline law, are, however, relatively more abundant, giving rise to a "grated" structure.

The crushing of the rock has given rise, as above noted, to molecular movements in the felspars, and the resulting abnormal extinctions make optical determinations of the felspar very difficult. A large number of very satisfactory measurements in sections from the zone perpendicular to (010)* gave 20° as the maximum. Sections parallel to (010) are beautifully zoned, the zoning indicating the existence of many more crystallographic forms than are shown by the present boundaries of the crystals, even where the latter are well enough developed to be recognisable. The (001) cleavage is sharply defined, and the (110) parting is indicated by the arrangement of decomposition products, thus enabling the section to be oriented. The extinction angle varies from 0° to − 2° for the outer zones to − 14° for the central portions. These extinctions agree in indicating that the felspar varies from basic andesine in the centre to oligoclase at the periphery.

In agreement with this determination are the facts that the refractive index of the peripheral zones is in all cases lower than that of quartz, while that of the central nucleus is in all cases higher.

Interpositions are not very numerous in the felspar. The principal individualised forms are small acicular prisms of apatite which range down to ultramicroscopic dimensions. The larger individuals do not appear to possess any regular arrangement, but the smaller ones seem to lie with their long axes parallel to the crystal faces as indicated by the zones. There is a little magnetite in grains and crystals, but this is not plentiful.

In the more undecomposed parts the felspar contains fairly numerous unindividualised inclusions in the shape of liquid and gas-cavities, the former with rapidly moving bubbles.

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* The measurements of the felspars throughout the whole of this investigation were carried out according to the methods elaborated by M. A. Michel Lévy in his "Etude sur la Détermination des Felspath dans les Plaques Minces" (Paris, 1894-1896).

When the felspar is considerably decomposed, the liquid disappears and the cavities become indistinct among the decomposition products. Though still fairly fresh, the felspars have suffered a certain amount of decomposition. This has given rise to a fair amount of kaolin in tufts and grains. The alteration has in some cases gone on most rapidly along the cleavage cracks, but is by no means confined to them. Cracks are common in the mineral which owe their origin to the increase in bulk of the materials during the process of alteration and hydration, and such cracks are injected with the resulting products. The kaolin is especially abundant along the (110) parting in sections parallel to (010). In addition to the kaolin, there are developed, here and there, small quantities of calcite, and light yellowish-green epidote. These are entirely confined to the central more basic portions of the felspar. The epidote occasionally forms small crystals, but is usually in the shape of irregular grains set in a matrix of lower refractive index, composed largely of calcite.

Of the ferromagnesian minerals biotite is the chief. It occurs in large irregular patches about 1·75 mm. diameter. These exhibit in a very marked manner evidences of the intense strain to which the rock has been subjected, in the bending, faulting and fraying out of the plates. Colour and pleochroism are quite normal. $\mathfrak{a}$ = golden-yellow. $\mathfrak{b} = \mathfrak{c}$ = very dark brown.

Absorption: $\mathfrak{c} = \mathfrak{b} >> \mathfrak{a}$.

When the principal plane of the polariser is parallel to the cleavage, the mineral is practically extinguished.

The biotite has suffered considerably from decomposition. In almost every section parts of the edge have become greenish in colour, with loss of intensity of pleochroism, though the latter is still strong in grass-green and straw-yellow tints. The double refraction of this decomposition product is very weak indeed; in fact, some sections are practically isotropic; most show the characteristic azure interference tints of the chlorites.

All stages of alteration can be traced, from a mere slight bleaching of the biotite to a mass of chlorite, often somewhat fibrous in structure.

In most cases the felspars are moulded on the biotite, but occasionally there is an interpenetration of the marginal portions of the two minerals, showing that the crystallisation of the mica had not completely ceased when that of the felspar commenced.

Interpositions in the form of small prisms of colourless apatite occur like those in the felspar. These do not give rise to pleochroic halos.

Hornblende, though less abundant than biotite, is nevertheless fairly plentiful. It occurs as completely allotriomorphic granules, usually independently developed, but in some cases intergrown with the biotite. The colour in ordinary light varies from light yellowish-green to strong green. Cleavage is quite normal, and in addition the mineral is much shattered by the crushing of the rock. The pleochroism exhibits no points out of the common.

$\mathfrak{a}$ = light greenish-yellow.
$\mathfrak{b}$ = dark yellowish-green.
$\mathfrak{c}$ = dark green.

The absorption scheme being: $\mathfrak{a}<\mathfrak{b}<\mathfrak{c}$.

The maximum extinction observed in the vertical zone was 22°. Almost all the sections exhibit the usual (010) twinning.

The crystallisation of hornblende has been almost synchronous with that of biotite, and the two minerals are irregularly intergrown. In most cases the basal cleavage of the mica appears to be parallel to the vertical axis of the hornblende, though an odd section here and there does not seem to follow this rule.

The alteration of hornblende is very similar to that of biotite, and in patches, where complete alteration has taken place, it is impossible to determine with certainty what the original mineral was.

The inclusions in the hornblende are so similar to those in the biotite as to call for no special mention.

A little magnetite is scattered through the sections, occurring as inclusions in all the essential minerals indiscriminately. In all cases it shows some trace of crystalline form. It is entirely free from decomposition products, and the surface reflects incident light brightly.

The only other important accessory mineral is apatite, which is sparsely scattered through the rock. It is enclosed in all the other minerals, even the magnetite, in small, quite perfect prisms.

The order of crystallisation of the individual minerals is normal. Considering the amount of mechanical and chemical alteration to which the rock has been subjected, together with the comparatively high lime percentage of the felspar, it is surprising that so little epidote has been formed.

Quartz Diorite (Nadranikula, Wainibua, above the village of Wainiveidro). Plate xxxv., fig. 2.

As described above, this point was the first point at which an extensive outcrop of plutonic rock was encountered.

Macroscopic characters.—The rock is, in mass, light grey in colour. It is strongly jointed, there being at least three regular sets of joints traversing it (see p. 474). An additional evidence of strain is afforded by a slight foliation, though this is not so marked as in the Narokorokoyawa rock.

The grain of the rock is medium, much finer than that of the Narokorokoyawa rock. The most obvious minerals are:—Plagioglase in fairly fresh-looking crystals and grains, 5-6 mm. in length, with very bright cleavage faces and noticeable striation; quartz, interstitial in character; hornblende in quantities quite subordinate to the felspar. On the joint-surfaces a greenish to yellow coating of a chloritic substance occurs, with a thickness of about a millimètre. The specific gravity of the rock is 2·70.

Microscopic characters.—The texture is hypidiomorphic granular. Plagioclase felspar is by far the most abundant constituent. These felspars are highly complex, and their determination is by no means easy. They are more or less idiomorphic in shape, with a granular habit. In ordinary light they are seen to be somewhat decomposed, but on the whole are fairly fresh. Zoning is a very marked feature, being indicated by differences of refractive index and arrangement of inclusions.

Observations in polarised light give rather puzzling results, and appear to indicate that more than one species of felspar is present.

The commonest type of felspar in the rock is certainly a basic variety of andesine, or an acid variety of labradorite. This is always fairly idiomorphic and strongly zoned. The decomposition products are approximately centrally grouped. In sections perpendicular to (010) the maximum extinction angle is 19°. In sections parallel to (010) the extinction varies from − 16° to − 25° for the different zones. The refractive index is in all cases higher than that of quartz.

The second type of felspar is far less abundant than that above described. It occurs in small allotriomorphic grains entirely free from decomposition products. In these the maximum extinction in the zone perpendicular to (010) is 6°, in section parallel to (010) it is − 4°. The refractive index is higher or lower than that of quartz according to the relative orientation of the two minerals. These sections must be rather basic oligoclase.

The third type of felspar is untwinned or twinned only according to the Carlsbad law. It is interstitial in character and very sparsely distributed. The decomposition products are abundant, and are evenly, not zonally, distributed. The refractive index is distinctly lower than that of quartz or Canada balsam. This mineral may be orthoclase, but is more probably anorthoclase, since other sections whose habit is exactly similar show traces of excessively fine lamellar twinning.

Except for the arrangement of the decomposition products, they do not call for very special description, as they consist practically entirely of kaolin. A little calcite and epidote are developed locally. The more basic felspars are decomposed centrally, but to a much smaller extent towards the periphery; while those felspars which have been referred to anorthoclase are pretty evenly affected. In all cases the products are more thickly grouped in certain planes than in others, and these planes are *not* the cleavage planes.

As inclusions, we have occasional prisms of colourless apatite with a marked tendency to arrangement parallel to faces of the host. Locally magnetite in minute crystals is very abundant. Here and there very minute hair-like crystals are quite plentifully developed; they are apparently opaque. They are for the most part straight, but an occasional geniculate twin indicates that they consist of rutile.

Quartz is much less abundant than felspar, and is entirely interstitial. The ragged areas and isolated grains are in some cases optically continuous over comparatively wide areas. On the other hand, the larger grains have suffered very considerably from crushing. As is usual, the other minerals show little or no sign microscopically of the crushing of the rock; while quartz, the hardest mineral present, has been very considerably splintered. Usually the effect is the production of shadowy extinction, or of areas whose positions of extinction are very close; but in some cases the action has proceeded further, and a coarse mosaic has been produced.

The individualised inclusions in the quartz are similar to those above described for felspar. In addition, fluid-cavities with moving bubbles are very abundant. In the smaller ones the bubbles move spontaneously. These cavities are distributed along roughly parallel planes, with intermediate clear spaces. The directions are fairly constant in each quartz grain, but the planes do not pass from grain to grain as is often the case.

Hornblende is less abundant than either of the above minerals. It is subidiomorphic to allotriomorphic in habit, and has suffered very much from decomposition, passing into a chloritic product. Refractive index and cleavage are quite normal. Double refraction is, perhaps, not quite so strong as usual. In sections parallel to the clinopinacoid the extinction is 18° from the trace of the vertical axis. Where undecomposed the pleochroism is strong :

$\mathfrak{a}$ = light brownish-yellow.
$\mathfrak{b}$ = dark brownish-bronze.
$\mathfrak{c}$ = dark bronze-green.

Absorption being : $\mathfrak{a}<\mathfrak{b}<\mathfrak{c}$.

Incipient decomposition is marked by a change in the character of the pleochroism. All the colours become more bluish, particularly those for the directions of maximum and minimum elasticity; $\mathfrak{c}$ in some cases is quite greenish-blue. Up to this stage the decomposition does not appear to affect the strength of the double refraction. As the process of alteration proceeds, the mineral splits up into fibres whose refractive index and double refraction are lower than those of the undecomposed substance. The interstices between the fibres are filled with a very weakly doubly refracting substance of yellow colour. The final stage of decomposition results in the production of aggregates of yellow-green or greenish-blue chlorite. Sometimes these aggregates are spherical-radial on a very small scale, each little sphere giving a cross between crossed nicols; in other cases the aggregates are homogeneous. The refractive index is low, and the double refraction exceedingly weak, much less than for apatite. The formation of this chloritic material is accompanied by the separation of grains, scales, and tufts of a white opaque mineral very suggestive of leucoxene. The presence of considerable quantities of other titanium minerals renders it by no means improbable that this is the nature of the white mineral.

Biotite is not recognisable. If it was present originally it has been entirely converted into chlorite. Some of the aggregates of the latter mineral are very fibrous, and suggestive of pseudomorphs after biotite; but, as all stages from these fibrous aggregates to almost undecomposed hornblende are met with, it is safer to refer all the chlorite to that source. In five slices of the rock not one recognisable piece of biotite was met with.

The most abundant and most important accessory mineral is sphene. It is present mostly in the form of irregular grains of yellowish-grey colour without pleochroism. A few of the sections show some approach to the lozenge-shape, and in these the unsymmetrical cleavage is well marked. The mineral is undoubtedly of primary origin.

The iron ore is magnetite, probably titaniferous. Where the sections are idiomorphic, they show the forms characteristic of magnetite. By reflected light, however, they are not so bright as magnetite usually is, and are associated with grey and brownish decomposition products.

The other accessory minerals are the small, relatively long prisms of apatite noted above as inclusions in the later formed minerals, and an occasional very small zircon.

With regard to the order of crystallisation, magnetite encloses apatite but is earlier than sphene. All three are earlier than hornblende, felspar, or quartz, which crystallised in that order. The crystallisation of the felspar referred to anorthoclase overlapped that of quartz to some extent, as the two are found intergrown in a semigraphic manner at times.

Diorite (Gravels of Navua River at Nakorowaiwai).

Macroscopic characters.—The rock is moderately coarse-grained. It is greyish in colour, and is speckled with hornblende. It consists principally of greyish felspar and very dark green hornblende; some biotite can also be recognised. Quartz is not very noticeable on the rolled surface, but on the polished surface is seen to be moderately plentiful. The greenish decomposition products of the hornblende and biotite are fairly abundantly distributed. Specific gravity 2·79.

Microscopic characters.—The texture of the rock is moderately coarse hypidiomorphic granular.

The constituent minerals include triclinic felspar, hornblende, biotite, a little interstitial quartz, small amounts of magnetite and minor accessories, and decomposition products. The rock is therefore almost a pure diorite.

The minerals as a whole are surprisingly fresh-looking, though the ferromagnesian constituents show signs of incipient decomposition. A certain amount of strain is evidenced by the fracturing of the felspars, bending of the micas, and undulose extinction in most of the minerals; but the absence of marginal crushing shows that the forces have not been very intense.

Felspar is the most abundant constituent of the rock. It occurs in idiomorphic and subidiomorphic sections averaging about 2·3 by 1·25 mm. in area. It is quite clear and colourless, and, though much cracked, is free from decomposition products. The usual cleavages are strongly developed. A study of the refractive indices proves that the felspars are complex in structure. Many of the crystals exhibit a large kernel with a refractive index about the same as that of quartz (sometimes slightly higher, sometimes lower), but always higher than that of Canada balsam. These kernels are surrounded by a broad, very sharply defined ring of felspar, comparatively free from the cracks which are so abundant in the kernel, and with a refractive index lower than that of either quartz or Canada balsam. In most cases there are only two such sharply defined zones, but in a few instances there are three or several rings.

In polarised light most of the sections exhibit albite lamellæ, with or without Carlsbad and pericline twinning. Some sections, proved not to be orthoclase by their refractive index and optical properties, show only the Carlsbad twinning without any trace of lamination after the albite law. In addition to the comparatively simple twinning, there is, in many instances, an excessively fine polysynthetic twinning sensibly perpendicular to the albite lamellæ, and usually affecting only a portion of the section. It is possible that this may represent the twinning after the pericline law, but as the latter form occurs well developed in other sections, this particularly fine lamination is very puzzling.

In spite of the comparative freshness of the felspar, it is difficult to find a section giving satisfactory measurements. The crushing of the rock as a whole has given rise to bending and faulting of the lamellæ, undulose extinction, and aggregate polarisation. Sections parallel to (010) are on the whole more satisfactory than those perpendicular to that face. The extinction of the outside zone varies from within outwards from $-6°$ to $-2°$, that of the kernel from $-28°$ to $-16°$. Taken in connection with the refractive index observations, these figures indicate a felspar varying between labradorite and andesine for the kernel, and zones of oligoclase of varying composition for the peripheral portions.

The sudden change in the composition of the felspar between the kernel and the outer coating is suggestive of a marked change in conditions of crystallisation after the formation of the inner portions of the felspar and before the final consolidation of the rock. No other evidence in support of the idea of a secondary addition to the felspar crystals could be found. As will be explained later, abundant evidence of this phenomenon is met with in certain of the andesites; but porphyritic structure, so characteristic of change of physical conditions during the consolidation of rock, is conspicuously absent in the present instance. I could find no evidence of rounding of the kernels before the crystallisation of the outer coat.

Inclusions are not very abundant in the felspar. There are gas-cavities and liquid inclusions with moving bubbles, all of very minute dimensions. Grains and short prisms of a yellow-green mineral which, by its refractive index, double refraction, and pleochroism, is seen to be hornblende, also occur. There are also small grains and crystals of magnetite.

Hornblende occurs in thoroughly allotriomorphic sections up to 2·6 × 1·0 mm. in area, scattered plentifully through the rock. Cleavage, refractive index, and double refraction are quite normal. The pleochroism is very strong.

$\mathfrak{a}$ = light greenish-yellow.
$\mathfrak{b}$ = dark yellowish green.
$\mathfrak{c}$ = dark green.
Absorption : $\mathfrak{a} < \mathfrak{b} \underset{<}{=} \mathfrak{c}$.

The extinction angle $\mathfrak{c} : c = 20^\circ$.

Many of the sections afford fine examples of the ordinary twinning on (100).

Decomposition has not proceeded to any great extent as a rule. The principal product is a bright green pleochroic chlorite. One patch of this, showing no trace of cleavage, and therefore probably parallel to (001), exhibits in convergent polarised light a sharply curved brush. The mineral is, therefore, biaxial, with a very small optic axial angle; the optical sign is found to be negative. The pleochroism of this decomposition product is bright grass-green for rays vibrating parallel to the cleavage, light straw-yellow for those at right angles. The double refraction varies from sky-blue tints up to a maximum which is fairly high for chlorite.

A considerable quantity of epidote is formed at the same time. In colour this is yellowish-green, and is easily recognised by its high refractive index, and strong double refraction, in grains scattered throughout the chlorite.

The only inclusion of importance is magnetite in grains and crystals.

Biotite is less abundant than hornblende, but is nevertheless an important essential constituent. It occurs in thoroughly allotriomorphic sections up to about 1·5 × 0·75 mm. in area.

Cleavage, refractive index, and double refraction are quite normal. As stated above, the mica plates are often bent owing to the strain which affects the rock as a whole. The pleochroism is as usual very strong; vibrations parallel to the cleavage are almost completely absorbed, while those vibrating at right angles give a strong yellow colour.

The mica shows the effects of decomposition to a much greater extent than the hornblende does. The earliest stages are marked by the occurrence of odd patches of chlorite in parallel position with regard to the original mineral. All stages between this, and a complete replacement of the mica by a mixture of chlorite, epidote, and opacite, can be traced.

The chlorite is similar to that described above under the decomposition products of hornblende. In the final stage it is usually impossible to say to which of the two species the original mineral belonged. As a rule the epidote derived from the biotite is rather lighter in colour than that from the hornblende, but it is otherwise very similar.

Included in the biotite are grains and crystals of magnetite.

Though intimately associated, the hornblende and biotite are not intergrown to any extent. Where any trace of such an arrangement occurs, the mica appears to be the older of the two.

In addition to the small grains of magnetite included in the ferromagnesian minerals, this mineral is fairly abundant in more or less idiomorphic sections throughout the rock.

Quartzite (Togicedra). Plate xxxv., fig, 3.

In hand specimen very little of the structure of the rock can be made out, as it very fine-grained and very uniform in texture. The colour is almost black, and the stone is intensely hard. As stated in the first part of this paper, the rock is very considerably jointed, but the bedding planes are in many cases obscure. When they are visible, the dip is at very high angles, but variable in direction and amount.

In thin section the rock is seen to consist of a very fine-grained aggregate, the base of which is a very fine mosaic of quartz and one or more other colourless minerals. Many of the colourless granules which have broken away from the edge of the section have a refractive index lower than that of Canada balsam. This material cannot be quartz. It is perfectly clear and colourless, shows no microscopic structures (cleavage, twinning, &c.), and possesses very weak double refraction. An acid felspar, probably albite, answers to this description. The principal coloured constituent is referable to amphibole. It occurs in minute prismatic sections whose minor limit of size is submicroscopic. The larger ones are greenish-yellow in colour, and noticeably pleochroic. The extinction angle is within about 10° of their direction of elongation. Refractive index is high, and double refraction quite strong. The colour for vibrations perpendicular to the length is light yellow; for those parallel to the length it is slightly darker greenish-yellow. The largest prisms are distinctly fibrous, and are frayed out at the end; the smaller individuals occur independently or clustered together to form tufts. The arrangement is on the whole irregular, but a more or less marked grouping in parallel layers imparts a foliated structure to the rock. In cross section the outline is rounded to irregular. No mica can be perceived. A little apatite in minute prisms is recognisable. Iron ore in rounded grains is exceedingly abundant. It is almost exclusively referable to magnetite, though an occasional speck of pyrites is present.

The rock is traversed by numerous irregular quartz veins, in which the quartz assumes the character of a mosaic.

Augite Andesite (Namulowai). Plate xxxv., figs. 4-5.

Macroscopic characters.—In hand specimen the rock is dark blue-grey in colour, and very compact in texture. It consists of a well-marked cryptocrystalline base, with very numerous, beautifully fresh, small, felspar phenocrysts, in which the albite striations can be readily seen with a lens. Much less abundant than the felspar is augite, in rather dark greenish-yellowish crystals, or nests of crystals. There is no distinct evidence of flow.

The outcrop described in Part i. of this paper is a remarkable thimble-shaped hill. It is very roughly columnar, so that the rock tends to break up into angular fragments from 4 or 5 inches in diameter upwards. Specific gravity, 2·64.

Microscopic characters.—The base consists of a light yellowish-brown glass, through which are scattered very numerous crystallites and microlites, giving it a characteristic hyalopilitic texture. The crystallites have the form of very minute straight or curved rods and fibres, and are irregularly interlaced without any obvious flow-structure.

Through the glass are scattered—but not abundantly—very minute microlites of felspar. These are square to lath-shaped sections, whose extinction is sensibly straight. No trace of twinning is to be seen. The characters observed agree, so far as they go, with oligoclase.

Still more scarce than the felspar microlites are those of augite. They take the form of rather slender prisms, with a faint yellowish colour, high refractive index, and large extinction angles.

One of the most remarkable features of the rock is the abundance of felspar phenocrysts. These vary in size up to about 1·75 mm. long. A few show perfectly sharply defined outlines, but most have more or less strongly marked resorption rims. All stages can be traced, from perfect crystals to mere hazy patches, where the base is lighter in colour than usual, marking places where felspar crystals have been almost completely redissolved.

The peculiarity in these felspars, which immediately attracts the attention, is the enormous abundance of inclusions, and their marked zonal arrangement. The actual nature of these interpositions will be considered later. Some sections contain none of them. In practically every instance the "inclusion zone" is bounded peripherally by a perfectly limpid ring. The shape of the "inclusion zone" indicates that the original crystal lost its sharp edges owing to corrosion, and the secondary felspathic material of rather more acid composition was added peripherally in optical continuity with the nucleus, reproducing the original crystal edges. These crystals have a refractive index higher than that of Canada balsam. The zones are remarkable, in that a more basic zone is usually interposed between the nucleus and the peripheral zone, sharply marked off from both by its higher refractive index and different extinction angle. In some cases the recurrence of several basic zones is to be noticed.

Sections in the zone perpendicular to (010) are apparently free from inclusions, and do not as a rule show much zoning, especially those with the maximum extinction angle. The maximum extinction angle obtained in a very large number of readings was 37°. The greater number of readings lay between 33° and 37°.

In sections of this zone twinning after the albite and Carlsbad laws is almost universal. One section, which does not exhibit Carlsbad twinning, shows that after another law. The plane of composition cuts diagonally across that of the albite lamellæ. I take this to be the Baveno law.

Sections parallel to (010) are very strongly zoned. The cleavages parallel to (001) are sharply defined, while those parallel to the prism face are in some cases marked by rough cracks. The zoning, indicating the presence of (001), ($\bar{1}01$), ($\bar{2}01$), allows the orientation of the section. It is thus found that the extinction angle varies from − 17° to − 28° for the different zones. The kernel is in all cases the most basic part, and usually occupies from one-third to one-half the area of the section. The most basic variety of felspar is thus Bytownite. This determination is in accord with the fact that the refractive index is fairly high. The double refraction is also noticeably greater than usual for a felspar. Observations in convergent light are not very satisfactory; they appear to indicate that in sections parallel to (010) an optic axis emerges just outside the field. This is what ought to happen for bytownite, but the figure is so hazy that it is impossible to be quite certain.

Augite phenocrysts are fairly abundant, though much less so than felspar. They are bounded in the vertical zone by $\{100\}$ and $\{010\}$ very strongly developed, $\{110\}$ just noticeable, and are terminated by $\{\bar{1}11\}$. The ordinary (100) twinning is present in a large number of cases. The prismatic cleavages are fairly perfect, but the rather uncommon cleavage parallel to (010) and perpendicular to the trace of the twinning plane is even more marked in many cases. The colour by transmitted light is very pale greenish-yellow. Faint as the colour is, a pleochroism is just observable. Its scheme is :

$\mathfrak{a}$ = very light yellow.
$\mathfrak{b}$ = „ „ green.
$\mathfrak{c}$ = „ „ brown.

The absorption is · $\mathfrak{a} < \mathfrak{b} < \mathfrak{c}$.

The average size of the crystals is about ¾ mm. long by ⅓ mm. thick.

The refractive index and double refraction are quite normal.

Many of the crystals are distinctly corroded, and show a marked resorption rim in which is developed some secondary magnetite. The inclusions in the augite are not very numerous; magnetite grains and crystals are by far the most abundant, but a few very small apatite crystals also occur. In addition to these there are a few indeterminate greenish plates which, when edge on, appear like threads.

The augite is practically entirely free from decomposition, not even a trace of chloritic material being observed, unless the plates just referred to are of this character.

In addition to the isolated crystals of augite scattered through the base, there are a few rosettes of crystals up to about a couple of millimètres in diameter.

The only other mineral to be noted is magnetite in grains and crystals up to about ½ mm. in diameter.

Some peculiar granular aggregates occur. They consist of small grains of rather more greenish augite than that noted above, clear basic felspar, magnetite, and a little brown glass similar to that composing the base. They range up to about ⅔ mm. in diameter.

As stated above, one of the most remarkable features of the rock is the exceptional development of inclusions in the felspar. In all instances they appear to be mainly tabular; and some sections, particularly those in the zone perpendicular to (010) giving extinction angles near the maximum, are apparently quite free from them. This is probably due to the fact that the interpositions have their maximum extension in (010), while their thickness is very small; or else such sections, being more or less through the centre of the crystal, have missed the crowded parts which are *on the whole more towards the exterior*. The individualised inclusions are of three kinds :—

(1). Faint greenish grains whose refractive index and double refraction indicate augite. The *uniformity of distribution of* their polarisation colours confirms the statement that they are platy.

(2). Clear prisms of minute size, perhaps slightly greenish in colour. Their refractive index is considerably higher than that of the felspar. They are crossed by a marked parting perpendicular to their length, and possess a noticeable double refraction. The extinction angle measured from the long axis of the prism is large, angles up to 45° being met with. The orientation is on the whole irregular, but sometimes short rods are arranged end to end in straight lines, with very small spaces between them, like the carriages of a railway train. They are especially abundant in, but by no means confined to, certain very much corroded crystals, and in these cases pass insensibly into the hair-like microlites in the base. Their exact nature is somewhat doubtful. They are certainly not hornblende (too high an extinction angle), but are more likely augite. They are, however, distinct from the perfectly definite augite microlites (No. 1 above). The two kinds occur in the same felspar crystal.

(3). Magnetite grains surrounded by radial and, in some cases concentric contraction cracks, are only sparsely distributed.

The most numerous inclusions are unindividualised. These consist of glass which in the smaller occurrences is colourless, but in the larger ones takes on the character of the base, that is, becomes brown in colour, and crowded with microlites. The small colourless ones are more or less rectangular in outline, and are of the nature of negative crystals (fig. 5). In almost every case these small inclusions contain a relatively fairly large fixed bubble, and are strikingly like those figured by Cohen.* The markedly brown inclusions are for the most part irregular in shape, and are probably more of the nature of solution cavities rather than true inclusions. In one or two of the most corroded crystals, distinct necks can be found joining them to the substance of the base. In those crystals which have been added to secondarily, the inclusions cease abruptly at the original somewhat rounded surface, and the more acid peripheral zone is quite free from them. The explanation of the arrangement of the inclusions is probably that the original basic felspars suffered very considerably from corrosion by the magma. The solution followed the plane of the (010) cleavage mainly. Afterwards, through change of conditions another period of felspar-building followed, and the outer inclusion free zone of acid felspar was added.

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* Sammlung von Mickrophotographien zur Veranschaulichung der mikroskopischen Structur von Mineralien und Gesteinen. Taf. viii., ix., x.

The chemical analysis of this rock made by Messrs. Stoddard and Mawson at the University of Sydney, by kind permission of Professor Liversidge, is as follows:—

SiO_2	58·92
Al_2O_3	16·95
Fe_2O_3	3·33
FeO	3·69
MgO	0·40
CaO	6·22
Na_2O	4·99
K_2O	3·08
H_2O at 110°	1·09
H_2O on ignition	1·27
Total	99·94

This indicates a somewhat basic andesite.

Pyroxene Andesite (from coarse volcanic breccia of Voma, Upper Waidina River).

Macroscopic characters.—The breccia, from which the rock here described was obtained, forms an enormous outcrop. It rises from the river-level in great cliffs which must be quite 1000 feet high. These cliffs limit the view in nearly all directions, the greatest distance visible being somewhat over a mile. The boulders range up to 4 or 5 feet in diameter, and are angular to subangular in shape. The groundmass is greyish in colour, and consists of comminuted fragments of rock similar to that composing the boulders. The latter in hand specimen is of a rather light blue-grey colour. It is minutely vesicular, the cavities being irregular in shape, and up to about 2 mm. in diameter. They are coated inside with a thin film of bluish-white substance which does not effervesce with acids. These give the rock a speckled appearance. There are numerous glassy striated felspars up to 3 or 4 mm. in length, with less abundant and less obvious small crystals of brownish translucent pyroxene. A certain amount of magnetite can also be detected. The presence of the cavities makes the determination of specific gravity in mass valueless as a criterion of chemical composition, and their small size would necessitate very fine crushing to eliminate the error.

The specific gravity in mass is 2·58.

Microscopic characters.—In thin section the rock is obviously rendered strongly porphyritic by felspar, augite and hypersthene. The base possesses a distinct hyalopilitic texture. The amount of glass is relatively large and is quite colourless. Through it are scattered such large numbers of microlites as to give it the appearance of a grey "felt" under low powers. Under moderately high powers these microlites are seen to consist of (1) very numerous straight and curved hair-like microlites undeterminable under a magnification of 750 diameters; (2) plentiful rod-shaped augites; and (3) small felspar laths.

The augite rods, with very sharply defined boundaries, run up to about 0·026 mm. × 0·006 mm. as a rule, a few odd ones being about twice as much in each direction. In colour they are greenish-yellow, and have extinction angles up to 45°. The double refraction is quite noticeable.

The felspar microlites are of about the same order of size as the augites, but their boundaries are by no means so sharply defined on account of their much lower refractive index. This is less than that of Canada balsam. The extinction angle, so far as it can be measured, is within a few degrees of straight. These facts indicate that the felspar is oligoclase.

Grains and crystals of magnetite are moderately abundant.

The vesicular character, so obvious in hand specimen, is much less marked in section. The irregular shape of the cavities makes them look like accidental holes in the section. The film of material immediately in contact with the walls is almost opaque, and shows white by reflected light. By transmitted light it is very dark brown on account of its opacity. It is apparently fibrous and isotropic. Here and there there are other zeolitic materials present in small quantities. Parts of this substance have a refractive index almost the same as that of Canada balsam, and are perfectly isotropic; other parts have a refractive index lower than that of Canada balsam, and are very faintly doubly refracting. The amount is small, and the properties obscure.

The felspars of the first generation vary in size up to 2·35 × 1·25 mm. They are very clear and free from decomposition. In many cases they are crowded with inclusions which are usually more or less zonally arranged. In some sections "dusty" inclusions are so abundant as to render the felspars almost opaque. These inclusions are described later. The zoning produced by isomorphous layers of felspars of varying composition is strongly marked by differences of refractive index in ordinary light, and by differences of double refraction in polarised light, especially in sections parallel to (010). The refractive index is in all cases markedly higher than that of Canada balsam. The cleavages parallel to $\{ 010 \}$ and $\{ 001 \}$ are sharply defined, while that parallel to $\{ 110 \}$ is marked by strong cracks.

Between crossed nicols almost all the sections exhibit albite twinning occasionally combined with that after Carlsbad and pericline laws. Zoning, expressed by differences in double refraction, is less marked in sections perpendicular to $\{ 010 \}$ than it is in some of the other rocks described: but, as stated above, it is a striking feature in sections parallel to $\{ 010 \}$.

Sections in the zone perpendicular to $\{ 010 \}$ give symmetrical extinctions up to a maximum of 32°, with a difference of 15° between the extinctions in the two parts of a Carlsbad twin. Good sections parallel to $\{ 010 \}$ give an extinction of $-11°$ for the peripheral, and $-24°$ for the central portions. These measurements indicate that the external zones consist of a basic andesine, while the central kernel is a basic labradorite.

The inclusions in the felspars may be divided into glassy and lithoidal, gaseous, individualised and "dusty."

The glassy and lithoidal inclusions are very variable in size and shape. As a rule they are round or irregular, but occasionally they approach the form of negative crystals. The glass is yellowish or brownish in colour, while the lithoidal portions contain thread-like microlites, and pass insensibly into those described as dusty.

The gas-cavities call for no special remark. They resemble the glass-inclusions in size and shape.

The individualised inclusions can be referred to augite and magnetite. In all cases the former is yellowish-green in colour, with perfectly normal refractive index and double refraction. It occurs in two distinct habits: (i.) rounded or irregular grains generally more or less centrally arranged, and (ii.) prisms exactly similar to those in the base arranged peripherally and generally parallel to crystal edges. The grains are mostly about 0·02 mm. diameter or smaller, though occasional fragments up to 0·2 mm. in length may be observed.

Magnetite grains are far less abundant than augite, and are usually about 0·02 mm. diameter. They are as a rule strongly idiomorphic.

The "dusty" inclusions have the form of minute lines and dots which are certainly connected with the phenomena of corrosion and rejuvenescence.

These latter effects are very strongly marked, some crystals having been almost entirely redissolved by the magma. Such sections exhibit what have been termed above "dusty" inclusions in enormous numbers round the periphery. They are connected with the magma in many cases, and form a sort of frayed out fringe of it extending towards the centre of the crystal. They are really solution cavities, and are so abundant in some sections that the original crystal has been converted into a veritable sponge. Sometimes they extend to the very centre of the crystals, in other cases a nucleus of clear, uncorroded felspar is left, while again they have travelled along several lines leaving clear portions between. This corrosion is by no means universal; in fact the bulk of the sections show little or none of it. I am unable to account for this selective effect, as there does not appear to be any notable difference in the composition between those affected and those left. It may be that the freedom of most sections may be apparent and not real. The solution may have affected only a very narrow zone, so that, when the section passes through the plane of corrosion, the felspar appears crowded with "dusty" inclusions, in other cases the great mass of unaltered mineral appears. The solution has certainly had a marked rounding effect in many cases.

The phenomenon of secondary addition or rejuvenescence is very obvious in the case of these felspars. In many instances there is a peripheral zone of perfectly clear felspar, of lower refractive index than the crowded portion, perfectly free from any trace of "dusty" inclusions. This zone is obviously secondary, since it gradually rebuilds the crystal edges of those individuals which had been thoroughly rounded by previous corrosion. The secondary zones contain prismatic inclusions similar to those of the base. Even those sections which do not exhibit corrosion, show by sudden differences of refractive index and double refraction that similar secondary growth has taken place.

Augite is fairly abundant in broad prismatic sections up to 1·7 mm. × 0·9 mm. in size, of a light yellowish-green colour. The prismatic cleavages are strongly developed, but the cleavage parallel to $\{ 010 \}$ noted in the Namulowai rock is not developed in this instance, though the crystalline development in the two cases is very similar. Twinning after the ordinary law, *i.e.*, parallel to $\{ 100 \}$ is well marked and common. There are also sections showing an intergrowth of augite and hypersthene. In these the hypersthene is inside and the augite outside, the two having the same vertical axis.

The maximum extinction angle of the augite in sections parallel to $\{ 010 \}$ is 40°.

The only inclusions worthy of note are grains of magnetite, often idiomorphic, round which the augite exhibits strain-structure.

Hypersthene is perhaps more abundant than augite; the sections are if anything a little smaller, but the difference in this respect is small. The two minerals are readily distinguished by their difference in colour, most sections of hypersthene having a pinkish tinge. The rhombic pyroxene is well developed in the prism zone in which it is bounded by $\{ 100 \}$ $\{ 010 \}$ and $\{ 110 \}$, all about equally developed. The vertical axis is terminated by symmetrically placed faces, but the angular measurements of these are not sufficient to determine the form definitely. The cleavages parallel to $\{100\}$ and $\{010\}$ are about equally well developed. The refractive index is very slightly lower than that of the augite, but the difference is very small. The pleochroism is quite strong:

$\mathfrak{a}$ = light brownish-red.
$\mathfrak{b}$ = honey-yellow.
$\mathfrak{c}$ = light green.

The absorption is: $\mathfrak{a} > \mathfrak{b} > \mathfrak{c}$, and is marked.

The distinction between the two pyroxenes is very pronounced between crossed nicols. Whilst the augite shows colours of the second order, the tint of the hypersthene rarely, if ever, rises above yellow of the first order. The straight extinction of sections in the pinacoidal zones is also a striking feature of distinction. The results in convergent light are far from satisfactory. Where interference brushes are obtained they are nearly straight, indicating an optic axial angle nearly a right angle. In consequence of this, measurements of sign are practically impossible. This feature, and the comparative faintness of the pleochroism, indicate a rhombic pyroxene about intermediate between bronzite and hypersthene. On account of the pleochroism, I have called the mineral hypersthene.

The inclusions in this rhombic pyroxene are similar to those in the augite.

The only other mineral to be noted is magnetite. This is plentiful in the form of grains up to 0·275 mm. diameter and perfect crystals of somewhat smaller size.

Hornblende Andesite (Buki Levu). Plate xxxvi., fig. 6.

The rock here described occurs, in the form of huge boulders, in an exceedingly thick mass of volcanic breccia which builds up the great bulk of the mountains, of which Buki Levu is the centre. The specimens described were collected, not on Buki Levu itself, but on the hill facing it, across a deep narrow ravine less than a mile wide. The base of the breccia is light grey in colour, and is composed of finely comminuted fragments of the same rock which occurs as boulders. The latter run up to 5 or 6 feet in diameter, and are all fairly angular.

Macroscopic characters.—In hand specimen the rock is light bluish-grey in colour, and very slightly vesicular. It is rendered porphyritic by very numerous striated felspar crystals 5 or 6 mm. long, and by less abundant but rather larger augites. As a rule, no hornblende can be detected macroscopically. The rock where vesicular is rendered amygdaloidal by having the cavities filled with white amorphous material. In most specimens there is a marked fluidal structure, but in some this structure is not apparent. The rock is almost perfectly fresh and free from decomposition. The specific gravity in mass is 2·60. This is a little low on account of the vesicles, but they are so small and scattered that they cannot affect the result to any great extent.

Microscopic characters.—In section the base consists of fairly abundant colourless glass crowded with microlites, thus producing a hyalopilitic texture. Through the glass are scattered what appear to be minute gas-cavities of rounded or irregular shape. These areas possess very dark borders, indicating a considerable difference in refractive index between their contents and the glassy base, but do not affect polarised light. Hair-like indeterminate microlites are very abundant, interlacing to form a "felt." Amongst the individualised constituents of the base, felspar, augite, and magnetite are practically all that are to be noted. The felspar microlites are lath-shaped, square or irregular. The lath-shaped sections are mostly untwinned, but their minute size makes the recognition of their properties extremely difficult. The extinction angle measurements are extremely unsatisfactory, but appear to be about 10° to 12° from the length. If this is correct it indicates either albite or andesine. The augite microlites are prismatic in shape. They are not nearly so abundant as felspars, and are easily distinguished from them by their higher refractive index, stronger double refraction, and by possessing extinction angles up to 45°. Magnetite is relatively plentiful in idiomorphic grains.

Fluidal structure is not universally exhibited by the microlites of the base, even in cases where it is very marked macroscopically in the arrangement of the phenocrysts.

Felspars of the first generation present idiomorphic sections up to 4 mm. × 3 mm. in area. They have suffered considerably from mechanical forces, and from corrosion by the magma, but are otherwise beautifully fresh. The zoning in ordinary light, which has been described in other rocks, is even more marked in this one. There seems to be a great tendency for the zonally-arranged inclusions to split up into concentric zones with clear spaces between. The zoning is also marked by differences of refractive index, the variation being normal—that is, the central portions having higher refractive indices than the peripheral zones. The refractive index of all parts is greater than that of Canada balsam. Both the ordinary cleavages and the prismatic parting are strongly developed.

In polarised light it is found that albite twinning is strongly developed, combined in many cases with that after the Carlsbad law. Pericline lamellæ are by no means uncommon. Sections in the zone perpendicular to $\{ 010 \}$ give symmetrical extinctions up to a maximum of 35° for the central portions and 25° for the peripheral zones, with a maximum difference of 15° between the two portions of a Carlsbad twin. Highly satisfactory measurements in a section parallel to $\{ 010 \}$ give $-13°$ for the outer zones, and $-22°$ for the kernel. These results are very concordant, and show that the felspar may be called labradorite, the different zones varying between the two limits of that species. The outer zones are near $Ab_1\ An_1$, the central portions near $Ab_3\ An_4$. The unindividualised inclusions in the felspars are exactly like those described in the rocks from Namulowai and Voma, especially the latter, and are certainly due to similar causes. The individualised inclusions are referable to augite in grains and prisms mostly from 0·001 to 0·003 mm. in greatest length, but in some instances as much as 0·075 mm., and grains of magnetite. Some of the larger augite lumps contain small but perfect octahedra of magnetite.

Augite of the first generation is fairly plentiful, though not to the same extent as felspar, in broad prisms up to 1·25 mm. long by 0·75 mm. wide, scattered irregularly through the base or grouped in nests of more or less intergrown crystals. The colour is light greenish-yellow. The prismatic cleavages are perfect, and the rather unusual cleavage parallel to the clinopinacoid (at right angles to the trace of the twinning plane) is developed here as it is in the Namulowai rock. There is nothing remarkable about the refractive index or double refraction. The highest extinction obtained in the vertical zone is 41°. Judging by the amount of curvature of the hyperbolic brush in convergent polarised light, the optic axial angle is not large. The augite contains as inclusions crystals of magnetite and also minute colourless prisms about 0·025 mm. long, whose refractive index is not very different from that of the augite. These prisms exhibit straight extinction and weak double refraction, and may be apatite. Gas- and glass-inclusions are moderately abundant up to 0·06 mm. in diameter, but mostly much smaller than this. The smaller glass-inclusions have the form of negative crystals and contain fixed bubbles. Though, on the whole, the augite is perfectly fresh, here and there patches of brownish serpentinous mineral are met with.

There are comparatively scarce areas throughout the rock which represent pseudomorphs after hornblende. Most of these are irregular or rounded in shape, but a few of them still preserve the typical outline of a cross section of hornblende and thus afford the key to the explanation of the more irregular ones. They all contain very abundant magnetite; in many cases this mineral constitutes almost the entire bulk of the pseudomorph. In other cases, however, there is admixed with the magnetite more or less perfectly clear and colourless pyroxene. This rock therefore indicates an intermediate stage between the pyroxene andesites of Namulowai and Voma, and the typical hornblendic andesites of Korobasabasaga and Korowaiwai.

Magnetite is fairly plentiful in irregular grains up to 0·3 mm. diameter and smaller idiomorphic crystals.

There are moderately numerous amygdules partially or wholly filling small irregular cavities up to 1 mm. across. The secondary material appears to consist mainly of opal, chalcedony, and a serpentinous substance. In many cases the walls of the cavities appear to be coated with a thin layer of perfectly clear and isotropic substance whose refractive index is lower than that of Canada balsam; this is probably opal. Next comes a zone of fibrous material, slightly milky, exhibiting very weak double refraction. The extinction of the fibres is parallel to their length, and the layer has all the appearance of chalcedony. The surface of the opaline layer may be described as "micromammillary," and the chalcedonic fibres, standing at right angles to this surface, are therefore somewhat radial. The serpentinous material is irregularly distributed. It is greenish-brown in colour and shows very faint pleochroism. The structure is distinctly fibrous radial, and the double refraction is noticeably higher than that of felspar.

These decomposition products are also distributed through the rock and fill cracks which pass through all the minerals indiscriminately. It is possible that the minerals described as opal and chalcedony may be zeolites. The serpentinous material is in part derived from the augite, but probably much of it represents the material removed during the destruction of the hornblende.

Hornblende Andesite (Korobasabasaga).

Plate xxxvi., fig. 7.

As stated in the first part of this paper, no outcrops of rock were met with in the ascent of Korobasabasaga until the crest of the ridge was reached, when the "plug" filling the southernmost summit was encountered.

The rock consists of an exceedingly coarse breccia. The base consists of almost white comminuted fragments of lava similar to that forming the ejected blocks. The dark prisms of hornblende are very noticeable constituents of it, as are also felspar splinters. The ejected blocks are very numerous and are mostly fairly angular in shape.

Macroscopic characters.—In hand specimen the rock is very light grey in colour, with very obvious glassy felspars and black hornblende prisms up to 2 or 3 mm. in length. Both minerals are strikingly fresh and idiomorphic. The felspars are strongly striated on the cleavage faces and are more numerous than the hornblende crystals. On closer examination fairly abundant augite is detected in the form of very small crystals of light honey-yellow colour, looking, in fact, almost like olivine. A little magnetite can also be observed.

The specific gravity of the rock is 2·61.

Microscopic characters.—The base is hyalopilitic in texture, consisting of microlites of felspar and augite, with some magnetite, and colourless interstitial glass in relatively rather small proportion. All the mineral constituents of the base are very minute in size. The felspars are the most abundant. In most cases their size is so small that twinning cannot be detected, but whenever the size is slightly greater than the average twin striation is observable. Measurements of extinction angles are unsatisfactory. The best of them never exceed 2° to 3° from the direction of elongation of the microlite. The refractive index is much the same as that of the Canada balsam. The species is therefore oligoclase.

The augite of the second generation does not appear to differ noticeably from that of the other andesites already described. If hornblende microlites are developed, they are undistinguishable from the augite. The magnetite is mostly in more or less sharply defined crystals of small size. In addition to these constituents whose nature can be satisfactorily determined, there are rather scarce and very minute prisms with moderate refractive index whose double refraction is so weak as to be scarcely noticeable. These are probably apatite.

Felspar is the most abundant mineral of the first generation. It is rather tabular in habit, parallel to (010) and is perfectly fresh, and, like the phenocrysts in the previously described andesites, has exceedingly abundant inclusions. Zoning is strongly marked by differences of refractive index, and in all cases there is a narrow peripheral zone whose refractive index exhibits a very considerable and very sudden drop from that of the next zone inwards. Twinning after the albite and Carlsbad laws is practically universal, and lamellæ after the pericline law are by no means infrequent. Measurements of extinction angles indicate that the outer zone of felspar is totally different in composition from the inner portion, and it is, therefore, in all probability of secondary origin. In the zone perpendicular to (010) the central portions give a maximum symmetrical extinction of 28°, while sections parallel to (010) give − 15° to − 19°, thus indicating labradorite. The secondary rim gives extinctions not sensibly varying from 0° in all sections, while its refractive index is almost exactly that of the Canada balsam. It is therefore oligoclase, that is, is identical in composition with the microlites of the base.

The inclusions in the felspar do not differ essentially from those described for the other andesites, except in the fact that the zone of dusty inclusions, which I take to be really solution-cavities, is noticeably narrower than in the other rocks. This, combined with the fact that the zone of secondary felspar is comparatively wide, indicates that the phenocrysts have suffered less corrosion before secondary addition of felspar began to take place than the corresponding crystals in the Buki Levu rock for instance.

As we should expect, in addition to augite and magnetite, we have, included in the felspar, grains of pleochroic hornblende.

Next in abundance to felspar is hornblende, occurring in perfectly idiomorphic crystals. In the prism zone these are bounded by $\{110\}$ and $\{010\}$, the latter less developed than is usually the case, so that cross sections appear almost rhombic. Along the vertical axis the crystals are terminated by what appear to be pyramid planes. The colours in ordinary light vary between dark clove-brown and greenish-brown. In all cases there is a very strongly marked resorption rim rendered opaque by the abundance of secondary magnetite. In some cases the resorption rim is narrow and sharply defined, but a complete series of structures from this to a pseudomorph of magnetite is met with.

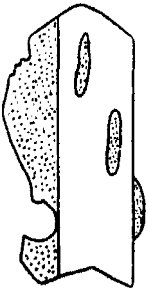
The ordinary prismatic cleavages are strongly developed, and, in addition, there are indications of another slightly irregular parting parallel to the clinopinacoid. This latter appears to be of the nature of a solution-plane, since it is marked by the development of dusty magnetite and plate-like bodies. It is not a very constant feature, and is observable in only a few sections.

The refractive index and double refraction appear to be about normal for basaltic hornblende. The highest extinction angle in the prism zone is 12°. Pleochroism is very strong, the scheme being: $\mathfrak{a}$ = straw-yellow.

$\mathfrak{b}$ = clove-brown.

$\mathfrak{c}$ = dark greenish-brown.

The absorption being sensibly: $\mathfrak{a} < \mathfrak{b} = \mathfrak{c}$.



Between crossed nicols the ordinary orthopinacoidal twinning is exhibited by most sections. In some it is simple in character, in others twin lamellæ are interposed between the two main portions. In one vertical section [parallel to (010)] it appears that two individuals are somewhat irregularly intergrown in twinned position (see text-fig.).

In convergent light, sections perpendicular to the prism zone show the emergence of a positive bisectrix slightly oblique to the plane of the section.

In addition to magnetite and apatite, neither of them very abundant, the hornblende contains liquid-inclusions with moving bubbles. The plate-like bodies referred to above are partly arranged parallel to the clinopinacoid, partly irregularly; in the former case they recall the "Schiller" structure of certain hypersthenes.

The pyroxene of this rock is almost colourless augite. It is far less abundant than hornblende. It differs slightly from the augite in the rocks hitherto described. The sections are sharply idiomorphic. In the vertical zone they are bounded by $\{100\}$, $\{010\}$, and $\{110\}$ about equally developed, so that cross sections are almost perfect octagons; along the vertical axis they are terminated by pyramid faces. The colour in ordinary light is very light greenish-yellow, the refractive index being about normal. Cleavages parallel to $\{110\}$ are rather imperfect, while those parallel to the vertical pinacoids are both rather strongly developed, though to a very unequal degree. A few of the crystals are twinned in the usual manner. The greatest extinction angle in the vertical zone was 39°, indicating (Lévy & Lacroix, 'Les Mineraux des Roches,' p. 262) a low percentage of iron. The double refraction is, for augite, rather weak. In convergent light a section rather oblique to the prismatic zone shows the emergence of a positive bisectrix almost perpendicular to the plane of section. The optic axial angle is small, since the hyperbolic brushes do not separate widely. The dispersion is not noticeable.

The augite is fairly free from inclusions, an occasional grain of magnetite being the only kind noticeable.

Magnetite is only moderately plentiful in grains and crystals scattered through the rock.

Olivine-bearing Andesite (Tama ni Ivi, Mt. Victoria).

Plate xxxvi., fig. 8.

Macroscopically the rock is bluish-grey in colour and very fine in grain. It is rendered strongly porphyritic by perfectly fresh striated felspar up to 5 or 6 mm. in length. Less abundant than felspar is augite, notably dark in colour when compared with that of the other rocks hitherto described. An occasional grain of yellow-green olivine is met with. Magnetite is plentiful in brightly reflecting octahedra of small size. Specific gravity, 2·73.

Microscopic characters.—In thin section the base is almost entirely crystalline. The amount of residual glass is small, so that the texture may be termed pilotaxitic. Where glass is recognisable, it is colourless and appears to be free from crystallites.

Of the microlitic constituents of the base, by far the most abundant is felspar. This occurs in lath-shaped sections which do not show any trace of fluxion arrangement. The refractive index is much about the same as that of the Canada balsam; if anything, rather lower on an average. In polarised light the laths appear either simple or twinned only according to the

Carlsbad law. The extinction angle, in a very large number of measurements, never exceeds 7° from the length. This indicates that the felspar is oligoclase, just on the boundary between albite and oligoclase.

Augite of the second generation is also abundant. It is greenish in colour and is darker than that which occurs in the less basic rocks hitherto described, and possesses apparently a rather higher refractive index, and stronger double refraction. These augites are distinctly prismatic. In addition, there are light green to colourless granules with high refractive index and strong double refraction, the latter apparently stronger than that of the augite. These are suggestive of olivine,* but are of too minute dimensions to be at all positive. Magnetite in small idiomorphic grains, and apatite in very slender crystals are also abundant.

Besides these constituents, there are very numerous hair-like microlites which do not appear to penetrate any of the other minerals, and are therefore probably the last minerals to crystallise.

Felspar crystals of the first generation are comparatively very large and abundant. They are perfectly clear and colourless, and free from decomposition products. Zones of growth are indicated in ordinary light by marked increase of refractive index from the periphery towards the centre. Both the principal cleavages are strongly developed, the cracks being numerous and sharply defined. The refractive index for each zone is well above that of Canada balsam. Like the porphyritic felspars in all the volcanic rocks before described, they are simply packed with interpositions, zonally arranged. These phenocrysts have suffered considerably from corrosion, in many cases being reduced to rounded grains. On the outside of these grains there has been subsequently added, in optical continuity with the central mass, a layer of felspar of much more acid composition, which has partially or completely built up the original crystalline shape of the mineral.

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* Rosenbusch states that two generations of olivine are very rare.

The internal portions of the felspar give, in sections from the zone perpendicular to (010), a maximum extinction angle of 32° for the inner zones and 26° for the outer zones, that is labradorite of varying composition. No sections parallel to (010) were available to check this result.

Augite of the first generation is not nearly so abundant as felspar. Its distribution in the rock is somewhat irregular, as it forms nests in some parts whilst some slices are almost without it. In the zone of the vertical axis the sections are neatly bounded by the usual faces, but at the ends of this axis they are irregular or bounded by pyramid faces; their length in proportion to their breadth is not great, so that they form stumpy prisms. The colour is light in greenish and yellowish tints, but is darker than the augites hitherto described. The mineral is perfectly free from decomposition. Pleochroism is noticeable but faint, the scheme being : $\mathfrak{a}$ = yellow.

$\mathfrak{b}$ = yellowish-green.

$\mathfrak{c}$ = somewhat bluish-green.

The difference of absorption of the rays is very slight. In polarised light the usual (010) twinning is noticeable, though far from common. The extinction in (010) is 46° forwards. Double refraction is more powerful than in the colourless augite of the other andesites.

The augite phenocrysts have suffered somewhat from corrosion by the groundmass, though not to the same extent as that of felspar. No difference in the character of the base in the immediate neighbourhood of these corroded augites can be detected. Interpositions with a marked tendency to zonal arrangement are abundant, and include magnetite and apatite, and liquid-cavities with moving bubbles; the smaller cavities have the form of negative crystals. It is worthy of note that olivine does not occur included in the augite phenocrysts.

Porphyritic crystals of olivine of relatively small size are somewhat sparsely distributed. Many of the crystals are beautifully idiomorphic, but some have been more or less damaged or even reduced to the condition of grains. It is perfectly colourless, but is slightly decomposed along the cracks, with production of dark brownish-yellow serpentine. The colour of this alteration product indicates a rather ferriferous variety of olivine. The fairly good cleavage parallel to (001) indicates the same thing; the other cleavages are not apparent, but rough cracks are numerous. Refractive index and double refraction are normal. Unlike the other phenocrysts, the olivine shows little or no trace of solution by the magma, the breaking up of the crystals being due to mechanical causes. In convergent polarised light a section perpendicular to an optic axis gives a distinctly curved brush, showing that the optic axial angle is smaller than usual. The dispersion is very distinct, $\rho < v$. Interpositions are rare, and include occasional grains of magnetite and apatite. Unindividualised inclusions were not observed.

Magnetite is fairly abundant, but calls for no special comment.

Apatite is a notable constituent in rough prisms which penetrate the magnetite.

Porphyritic Basalt, approaching Limburgite (Nadarivatu). Plate xxxvi., fig. 9.

Macroscopic characters.—In hand specimen the rock is dark bluish-grey in colour. It is very markedly different at first glance from the andesites hitherto described, in that porphyritic felspar is not developed. The rock is nevertheless very strongly porphyritic, the phenocrysts being black augite and yellow-green olivine. The former is strongly idiomorphic, the forms being ideally perfect, bounded by $\{010\}$, $\{100\}$, $\{110\}$ and $\{\bar{1}11\}$. The olivine, too, is beautifully crystallised; it occurs both as isolated crystals and as clusters of these. The two minerals are about equally abundant; if anything, the olivine is predominant. Magnetite is plentiful.

The rock is slightly vesicular, the spaces being filled with white zeolitic products. Specific gravity 2·90.

Microscopic characters.—In thin section it is obvious that this rock is much the most basic encountered during the whole expedition. Macroscopically no porphyritic felspars are visible, and under the microscope felspars of the second generation are small and not plentiful. On the other hand, ferromagnesian minerals are very abundant.

The base is certainly hyalopilitic, the amount of isotropic material being variable but notable. Under the magnification necessary to examine it, it is only very faintly yellow, and not much darker under low powers. It is crowded with hair-like crystallites, for the most part isotropic. The microlitic components of the base include plagioclase and augite, with a marked fluxion arrangement. Both minerals are of minute dimensions. Augite is the more plentiful of the two, and is very similar to that already described in other rocks. It is perhaps more strongly refracting, and its double refraction is greater. The felspar is mostly striated after the albite law. The refractive index is greater than that of Canada balsam, where a difference can be detected. Fairly good symmetrical extinctions up to 30° can be measured; with a difference of over 10° in the halves of an occasional Carlsbad twin, this indicates labradorite.

Of the phenocrysts, augite and olivine are much the most abundant. The former occurs in large sections, up to as much as 6 mm. diameter. It is beautifully idiomorphic, the forms indicated by the outlines of the sections being $\{100\}$, $\{010\}$, $\{110\}$, $\{\bar{1}11\}$ and $\{001\}$. The length is on the whole not much greater than the breadth, so that the sections are more or less equidimensional. The colour is rather variable; in different sections it shows tints of greenish-yellow or olive-green considerably different from one another. Notwithstanding this, no pleochroism is noticeable in any one section. Even in one and the same crystal the colour varies zonally, showing that the difference in colour depends on variation in composition and not on the direction of the section, thus explaining the absence of pleochroism. Some of the sections show most beautifully the "hour-glass" structure often met with in augite. Cleavage, refractive index and double refraction are quite usual. Twinning after the orthopinacoid law is not very common, though beautiful examples are met with. The extinction on the clinopinacoid is 52° forward from the trace of the vertical axis. Sections nearly at right angles to an optic axis give an hyperbolic brush with very little curvature, showing that the optic axial angle is large. These facts all indicate augite rich in iron.

The augite is not decomposed to any notable extent, but has suffered somewhat from corrosion by the magma. The resulting rim is rendered dark by development of magnetite. Many of the crystals are fractured by movement due to the flow of the rock. In one or two cases solution has gone on along planes parallel to the pyramid faces, producing relatively large cavities filled with, and often visibly connected with, the groundmass.

In addition to these pseudo-inclusions, there are numerous true interpositions. The chief of these is olivine in relatively large grains, and magnetite in more or less idiomorphic forms.

Olivine is perfectly idiomorphic, the shape of the sections indicating that none of the pinacoid faces are very strongly developed. The mineral is perfectly colourless, its refractive index and double refraction calling for no special remark. The cleavages are, however, very much more strongly developed than usual; in fact they are in certain sections quite perfect. All three pinacoidal cleavages seem to be present. This may indicate that the olivine is a ferriferous variety. This appears to be borne out by the fact that relatively little corrosion has taken place. The optic axial angle is large, judging by the slight curvature of the hyperbolic brush in convergent polarised light. The crystals are slightly corroded in parts, "bays" of groundmass being produced. The only inclusion of note is magnetite; as noted above, the olivine is older in crystallisation than augite. The cracks which traverse the crystals fairly abundantly are not so irregular as usual, but show a decided tendency to spheroidal arrangement strikingly similar to perlitic structure in glassy rocks. The mineral is often grouped in the form of nests of crystals, or occurs in isolated sections. As a rule the positions of the intergrown individuals do not seem to obey any fixed law, but in one case two such individuals are very nearly, but not quite, in parallel position. The mineral is slightly decomposed, especially at the periphery and along the *spheroidal* cracks, into a dark green variety of serpentine which is noticeably doubly refracting, but only very faintly pleochroic.

It is doubtful whether any of the felspar is truly porphyritic in the sense of Rosenbusch. Some of the sections are comparatively large, though always much smaller than those of augite or olivine. All stages between these and the microlites of the base can be traced, and no difference in composition is apparent. Magnetite is abundant, the grains showing more or less crystal form.

The cavities in the rock are of two kinds—long, irregular cracks, and round holes. The nature of the filling material is rather puzzling. Some of it has all the characters of an acid felspar; it is striated, and has a refractive index lower than that of Canada balsam. In some cases the lines of felspathic material can scarcely be called cavities, as they are only just discernible in the groundmass. In these felspathic lines, but not in the round holes, prisms of apatite occur abundantly. In both cases plates of reddish pleochroic mica are very scarce. Some of the round cavities contain undoubted zeolite, whose refractive index is very much less than that of Canada balsam. It is colourless, with opaque-white decomposition products thinly scattered through it. It is more or less markedly in broad prismatic crystals whose arrangement is either radial, irregular, or sheaf-like, suggesting stilbite. Owing to the superposition of the crystals, it is difficult to read extinction angles. Where this can be done the extinction is nearly, but not quite, straight. The double refraction is of the same order as that of felspar, though somewhat weaker. The crystals are crossed by cracks at right angles to their length. The elongation of the fibres is optically negative. All these observations, so far as they go, are in favour of the zeolite being stilbite. The broad distinct lines of colourless material through the rock contain a good deal of this same zeolite which encloses apatite; unless this apatite is secondary, the zeolite must be regarded as primary, like the analcite of the Sydney basalts.* The evidence, however, is not strong enough for any such hypothesis to be advanced in this case.

EXPLANATION OF PLATES XXXV.-XXXVI.

Plate xxxv.

Fig. 1.—Granite—Narokorokoyawa—showing effects of strain in the bending of the cleavage lines in biotite (× 20 diameters).

Fig. 2.—Quartz-Diorite—Nadranikula (× 20 diameters).

Fig. 3.—Quartzite—Togicedra—showing injection of the rock by quartz veins; *crossed nicols* (× 20 *diameters*).

Fig. 4.—Augite Andesite — Namulowai — showing characteristic group of augite crystals and general features of rock (× 20 diameters).

Fig. 5.—Glass-cavities in felspar, augite andesite — Namulowai. The cavities contain relatively large bubbles which remain fixed. The larger inclusions are irregular, while the smaller ones have the form of negative crystals (× 400 diameters, about).

Plate xxxvi.

Fig. 6.—Hornblendic Andesite—Buki Levu—general character of the rock (× 20 diameters).

Fig. 7.—Hornblende Andesite—Korobasabasaga (× 20 diameters).

Fig. 8.—Olivine-bearing Andesite—Tama ni Ivi—to show the mode of occurrence of the olivine. The particular portion of the rock photographed contains no augite (× 20 diameters).

Fig. 9.—Porphyritic Basalt—Nadarivatu. This photograph shows well the characteristic development of the olivine, and fairly well the tendency to Spheroidal Cracking (× 20 diameters).

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* G. W. Card, Rec. Geol. Surv. N.S.W., Vol. vii., p. 93, *et seq.*

THE BACTERIAL ORIGIN OF THE GUMS OF THE ARABIN GROUP.

X.—THE PARARABIN GUM OF STERCULIA.

(*BACT. PARARABINUM*, n.sp.)

BY R. GREIG SMITH, D.SC., MACLEAY BACTERIOLOGIST TO THE SOCIETY.

The gum which sometimes exudes from specimens of Sterculia has been investigated by Maiden,* who found that it consisted essentially of arabin and pararabin.† The latter is presumably a modification of the former, and differs from it in being insoluble in water. Pararabin also differs from arabin, as well as from metarabin or cerasin, in not being hydrolysed upon boiling with dilute sulphuric acid.

I have already shown that arabin is the product of *Bact. acaciæ*, and that metarabin is produced by *Bact. metarabinum*. It would, therefore, be interesting if an organism capable of forming pararabin could be isolated. Such a result would not only show how diverse can be the gum-products of bacteria, but also how the gums, which were supposed to be secretions of the higher plants in a pathological condition and to have been produced from cellulose, are really the byproducts of the bacterial fermentation of sugars.

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* Maiden, Pharm. Jour. [3] xx., 1890, 381.

† Pararabin found in beet-root, carrots, agar-agar, is amorphous, swells in water, is soluble in dilute mineral acids, and is precipitated therefrom by alkalies or alcohol; upon warming with alkalies gives arabin, with dilute H_2SO_4 no sugar, does not decompose carbonates. — Dammer und Rung, "Chemisches Handwörterbuch."

Specimens of the fruit, etc., of *Sterculia diversifolia*, showing numerous gum-drops upon the seed-capsules and twigs, were sent to me by Mr. H. W. Potts, Principal of the Hawkesbury Agricultural College. The substance of the capsules was saturated with a mucilage which oozed through insect punctures in the pods, and formed gum-drops upon the outside as it dried. From these specimens I hoped to obtain an organism capable of forming pararabin.

Bacteria were readily obtained, in the manner that I have previously described, from portions of the punctured fruits, from the very young entire fruits (measuring about 1 cm. in length) and from unpunctured twigs.

The colonies were those of *Bact. acaciæ*, and of races of another bacterium which was closely investigated. Since the bacteria were obtained from the twigs and unpunctured young pods, it is clear that the plant had not been infected by the same insects that made the holes through which the gum exuded. Infection must have occurred at another place, possibly on the stem, and at a less recent date.

When infected upon the surfaces of plates of saccharose-potato-agar, the unknown bacterium grew as a whitish slime which could be readily removed. A watery suspension of the slime was coagulated by copper sulphate (1% and 10%), ferric chloride, aluminium hydrate, lead acetate (10%), basic lead acetate, baryta water, milk of lime, and silver nitrate (5%). Upon standing a sediment separated out from the slime, and the almost clear supernatant liquid also gave precipitates with the reagents enumerated.

When the specimens of fruit arrived at the laboratory, several pods were soaked in water, and the mucilage which exuded was precipitated with alcohol. But a small precipitate was obtained from a fairly mucilaginous solution, and when this small quantity was dissolved or diffused in water it was precipitated by lead acetate, baryta water, copper sulphate, silver nitrate, and slightly with ferric chloride. These reactions were sufficient to show that the Sterculia mucilage and the bacterial slime have certain common properties, and that the organism which I had separated would eventually be found to be a pararabin-producer.

The coagulation of the slime by all the reagents enumerated is not characteristic of Sterculia slime, for I have already shown that cane gum is also precipitated or coagulated. The slime of *Bact. persicæ*, the arabinan-galactan organism of the peach, etc., when in strong solution, is also coagulated by these reagents. The slimes of *Bact. persicæ* and *Bact. vascularum* differ from the Sterculia bacterium slime, in that they are not resolved by treatment in the autoclave at three atmospheres' pressure into a deposit of bacterial remains and an almost clear or turbid supernatant gummy fluid. In this respect there was an agreement between the Sterculia bacterium slime and the slimes produced by the arabin and the metarabin bacteria.

The turbid solution of the gum, when treated with alcohol, gave a precipitate which consisted of large curdy masses and floccules. As the saline matter was removed during the process of eliminating the last traces of sugar, the alcohol threw down a precipitate, and at the same time produced a "milk." The precipitate was only partly soluble in water; the alcohol had gradually converted much of the carbohydrate into an insoluble modification. Saline flocculating agents, such as potassium chloride or better barium chloride, coagulated the "milk," and by dissolving the precipitate in water an opalescent solution was obtained.

The insoluble gum dissolved readily in dilute hydrochloric acid, but boiling 1% sodium hydrate simply coagulated the diffused or swollen carbohydrate, leaving a clear solution. The solubility in dilute acid and insolubility in dilute alkali are characteristic of pararabin.

The slime was obtained by growing the bacterium upon the surface of an agar medium containing 5% saccharose and 50% potato juice. The potato juice and the medium should not be neutralised at any time during its preparation. The natural acidity undoubtedly favours the production of slime, causing it to be more gummy and less opaque; evidently there are less bacterial cells and more gum. When neutralised potato juice is used there is obtained a smaller quantity of a thick white slime. Whether the increase of gum is due to the acid reaction of the medium or to the partial inversion of the saccharose is not clear; but, since reducing sugars are present in potato extract, it is probable that the natural acidity is the essential factor in stimulating the bacteria to slime-production rather than to reproduction.

The races of the organism.—Upon saccharose-potato-agar the bacteria always produced slime—that is to say, if the bacteria grew at all, slime was produced. Three races of the bacterium had been isolated, and these differed chiefly in the temperatures between which they grew. Race i., produced as much slime at 18° as at 24°; at 30° and 37° the slime was less. Race ii., grew equally well at 18°, 24°, 30° and 37°. Race iii., grew equally well at 18°, 24° and 30°, but did not grow at 37°. Race i., produced the largest quantity of slime, and it is this race which was used in the work connected with the action of the organism.

The slimes (*i.e.*, carbohydrate together with the bacterial cells and other products) which were produced by these races behaved differently to certain chemical reagents. For example, the slime of race i., was coagulated by copper sulphate, neutral lead acetate and barium hydrate, while races ii. and iii. were not. The slimes of all the races were coagulated by ferric chloride, aluminium hydrate, basic lead acetate, and milk of lime. The coagulation of the slime by many reagents is therefore not distinctive.*

When the gum was separated from the bacterial cells and other products and while in the soluble condition it behaved somewhat differently with these reagents. Curdy precipitates were obtained with alcohol, barium hydrate, basic lead acetate and ferric chloride. Neutral lead acetate and copper sulphate gave no precipitate. Copper sulphate followed by sodium hydrate gave a light blue precipitate which contracted but did not darken upon heating. In this respect it is similar to the arabin and metarabin gums. Fehling's solution sometimes did and sometimes did not precipitate the gum. These tests were made with the gum of race i., after the slime had been heated in the autoclave and the separated gum had been repeatedly precipitated with alcohol to remove the sugars.

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* The slime of *Bact. persicæ* differed in its behaviour to copper sulphate according to the temperature of incubation of the cultures. These Proceedings, 1903, p. 339.

The bacterium also produces slime in fluid culture. A medium containing saccharose 50, peptone 2, ammonium chloride 1, potassium phosphate 1, magnesium sulphate 0·5, chalk 10, and water 1000 grms. was, after sterilisation, infected and incubated at the air temperature (25°). By the 10th day, the solution had become very viscous, and from it a small quantity of slime was obtained by treatment with alcohol. When made into an emulsion with water, the slime behaved to reagents like that grown upon the surface of agar.

The products of hydrolysis.—The slime from agar was purified by repeated precipitation with alcohol from aqueous emulsion until it was found to be free from sugars. The gum was then obtained from the slime and its hydrolysis was attempted by boiling with 5 % sulphuric acid. At the end of six hours a portion was abstracted, neutralised and tested for reducing sugars. Fehling's solution gave a pale blue flocculent precipitate, but there was no reduction. At the end of twelve hours Fehling's solution gave the same negative reaction. The carbohydrate had not been hydrolysed, and in this respect it is similar to pararabin, which is not hydrolysed upon boiling with dilute sulphuric acid.

The sulphuric acid solution was divided into two and one of the halves was evaporated to half volume (= 10 % sulphuric acid) and boiled for six hours. The other half was nearly neutralised with baryta water, filtered and evaporated down with 50 c.c. of normal phosphoric acid until the solution darkened in colour and evolved the odour of burning sugar. The solution was then diluted to 33 c.c. (= 5 % solution) and boiled for six hours. From the solution which had been boiled with 10 % sulphuric acid, a few milligrams of an osazone which melted at 177-180° were obtained. The small quantity of osazone from the solution, which had been treated with phosphoric acid, melted at 168-169°. Both osazones were put together and dissolved in weak alcohol. The alcohol was boiled off and a water-insoluble, lemon-yellow, crystalline powder which melted at 191° was obtained. From the hot water solution crystals separated out on cooling; these dried on porcelain as a brownish-yellow skin which melted at 170°. The appearances and melting points of these osazones indicated galactosazone, and a mixture of arabinosazone and galactosazone.

As the quantities of sugars obtained by the above methods had been too small to enable the osazones to be separated in a practically pure state, a further quantity of gum was hydrolysed. This test differed from the former in the gum having been obtained in fluid media containing saccharose. The possibility of agar contaminating the gum was thus prevented. The carbohydrate was freed from saccharose and reducing sugars by repeated precipitation with alcohol from aqueous solution or suspension. The curdy gum finally obtained was moistened with 2 c.c. of strong sulphuric acid and was then rubbed into a paste in a glass mortar. When the mixture had become brownish in colour, 25 c.c. of water were added, and, after transferring to a flask, the mixture was boiled for 9 hours under a reflux condenser. The solution, which contained reducing sugars, was neutralised with barium carbonate, filtered, evaporated, clarified with aluminium hydrate and finally treated with phenylhydrazine mixture* and heated on the water-bath for two hours. The solution was cooled and the residue, after filtration, was dried on porcelain and then treated with ether to extract the tarry impurity. The osazones melted at 175-177°.

The undoubted mixture of osazones was successively treated with (1) hot water, (2) hot dilute alcohol, and (3) hot strong alcohol. The first fraction consisted of a mass of yellow crystalline needles which dried on porcelain as a brown skin and melted at 162-164°. Further treatment with hot water extracted arabinosazone melting at 159°. The second fraction dried as a loose yellow powder with a brown tinge. It melted at 184-186°. The third fraction dried as a loose yellow powder which melted at 190-191°. This was dissolved in hot alcohol, and hot water was added until a workable precipitate settled out. The clear yellow powder so obtained was galactosazone melting at 194°.

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* Phenylhydrazine 1 c.c., glacial acetic acid 1 c.c., water 0·5 c.c.

The slime has thus been seen to contain a carbohydrate which had the properties of pararabin, viz., upon drying it became insoluble, and this modification was insoluble in dilute alkali, soluble in dilute acid; it could not be hydrolysed by boiling with dilute acid, but by appropriate treatment with strong sulphuric acid it was hydrolysed to arabinose and galactose.

Invertase is not secreted.—Many bacteria while producing gum from saccharose invert a part of the sugar to levulose and dextrose, one of which may be utilised. This organism does not secrete invertase. The supernatant liquid from saccharose-chalk cultures did not reduce Fehling's solution. Instead of reducing the fluid, the gum formed a precipitate which coagulated on boiling.

The influence of various sugars, &c., upon slime-formation.—In the culture media hitherto employed saccharose had been the carbohydrate nutrient. But as other carbohydrates might be capable of replacing saccharose, experiments were made to investigate this question. The results showed that dextrose, levulose, galactose, mannite and glycerine could replace saccharose. Of these levulose and glycerine were better than the others, and better even than saccharose. The following carbohydrates were useless: raffinose, lactose, maltose, inulin, starch and dextrin. The experiments were made with a peptone and chalk fluid, and also with nutrient meat-agar, to both of which media the carbohydrates had been added previous to sterilisation. The fluid cultures corroborated the results obtained with the agar medium. Potato-extract-agar was also used, but as this medium contains reducing sugars, it did not show clearly the effect of the added carbohydrates. There was one exception, however. The addition of glycerine produced a gelatinous growth, the bacteria being apparently contained in comparatively large masses of slime. These masses were also noted when glycerine had been added to the nutrient agar. They lay loosely upon the agar and could be scraped together into a gelatinous heap.

Since the gum can be formed from glycerine, this substance should be much better than saccharose when the gum is required in quantity, for the residual glycerine could be more easily removed. Furthermore, a whiter gum could be obtained; the saccharose solutions during sterilisation, etc., become brownish in colour, and as this colour is conveyed to the purified gum, its solutions are not colourless.

The other byproducts of the fermentation of saccharose.—A saccharose-peptone-medium contained in a small flask was infected with the organism and connected with another flask containing baryta water. The air inlet was sealed with a screw-clip and the air outlet was connected with a tube of soda-lime. No aerial carbon dioxide could therefore gain access to the apparatus. At the end of five days the air from the culture flask was drawn through the baryta water, when a copious formation of barium carbonate occurred. Carbon dioxide is thus a byproduct in the fermentation of saccharose.

The supernatant liquid from a 20 days' culture containing chalk and saccharose was treated with barium hydroxide and boiled under an inverted condenser in order to saponify alcoholic esters. The liquid, after cooling, was filtered and distilled in a partial vacuum until about one-third had passed over. The residual fluid was evaporated down and reserved for the extraction of the acids. The distillate was distilled and the process repeated until about 10 c.c. of fluid had been obtained. As this contained ammonia it was made acid to litmus with phosphoric acid and distilled at atmospheric pressure. The first 2 c.c. of distillate were absorbed with anhydrous sodium carbonate and distilled. The first drops that passed over were collected and the boiling point determined by Siwoloboff's method. The fluid boiled at 78° and burned with a blue flame. It also gave the iodoform reaction, and undoubtedly was ethyl alcohol.

The residual fluid reserved for the extraction of acids was evaporated to small bulk, acidified with sulphuric acid and filtered. The residual chalk, with adhering salts and liquid from the culture flask, was also treated with dilute sulphuric acid until all the chalk had been decomposed and the suspension was strongly acid; it was then filtered. The two filtrates were reserved for extraction with ether.

The two residues of sulphate of barium and calcium were dried in the air, then ground to a rough powder in a mortar, and finally extracted with ether. After the evaporation of the ether, the extracted acids were treated with hot water, when an oily acid separated out. This was washed with water, dried, dissolved in ether and filtered. After the ether had evaporated, the fatty acid, which was solid at the ordinary temperature, was melted and sucked into capillary tubes in which the acid crystallised in clusters of silky needles. These melted at 42·5°, and apparently consisted of lauric acid.

The reserved filtrates were extracted with ether in Schoorl's apparatus, and, after the ether had been distilled off, the residual solution of the acids was added to the liquid from which the lauric acid had been obtained. The volatile acids were driven off in a current of steam. The proportion of these to the residual or non-volatile acids was as 1 : 9·7, or roughly as 1 : 10. The volatile acids consisted chiefly of butyric, with small quantities of acetic and formic acids. The partial separation of the acetic and butyric acids was effected by the treatment of the calcium salts with strong alcohol as recommended by Schoorl,* and the recognition was made by the odour of the acids and the ethyl esters. The solution of the non-volatile acids was evaporated and allowed to crystallise overnight, when prisms of succinic acid separated out. These sublimed, gave a buff precipitate with ferric chloride and ammonia, and melted at 180°. The method of Schoorl was then followed, when a further separation of succinate was effected. No other acids were obtained.

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* Schoorl, Jour. Soc. Chem. Ind., xix., 567.

The acids produced during the growth of the organism in saccharose solutions are therefore succinic, lauric, butyric, acetic and formic, the relative proportions being in that order. Besides these acids, ethyl alcohol and carbon dioxide are formed.

The organism did not produce characteristic growths upon the various media. The most distinctive characters were perhaps the production of a gummy slime on saccharose-potato-agar, and of a pronounced viscosity in fluid media containing certain sugars, etc., and chalk. As pararabin has never before been shown to result from bacterial activity, it is probable that the organism is new,* and I have accordingly named it *Bacterium pararabinum*, n.sp. (*Bacillus pararabinus*, n.sp., by Migula's nomenclature).

BACTERIUM PARARABINUM, n.sp.

Shape, etc.—The organism appears as an actively motile, short thick rod with rounded ends. It tends to form long rods, chains, and threads in old cultures. The young cells, as taken from a 24 hours' agar culture, measure 0·6-0·7 : 0·8-1μ. The flagella may be single and terminal, or numerous and peritrichous; up to seven have been observed upon one cell. The rods colour readily with the ordinary stains, and are decolorised by the Gram method. Spores were not observed.

Temperature, etc.—The growth temperatures have been noted on page 544. The bacterium is aërobic; no growth occurred under the mica plate.

Nutrient agar plate.—At 30° the colonies are circular, raised translucent-white and gummy. Microscopically they are rounded and finely granular, with irregular curved structures scattered here and there. The deep colonies are oval, rounded or lenticular, and coarsely granular.

Glucose-gelatine plate.—In two days at 22° the colonies were white, rounded, raised and gum-like, although they did not draw into threads when touched with the needle. Microscopically they were coarsely granular and clouded, with curved or coiled structures scattered throughout the colony. The deep colonies were round and dark, with short delicate cilia radiating from the margin.

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* *Bact. gelatinosum betæ*, Fritz Glaser, a dextran bacterium, appears to be the most closely related slime-forming organism.

Nutrient agar stroke.—The growth appears translucent-white, raised, moist or fat glistening, smooth or rough; the margin remains straight or becomes lobular. The consistency is either thin or gelatinous.

Saccharose-potato-agar stroke.—The growth may be (1) raised, luxuriant, translucent-white and non-gravitating; (2) white, gummy and gravitating; or (3) thin, white, spreading, with gas production in the condensed water.

Nutrient gelatine stab.—The growth along the needle track appears filiform, with a white, raised or depressed, glistening or dull nail-head. As the nail-head spreads outwards, the centre sinks, and a tubular or crateriform pit is formed, below which the medium is locally liquefied.

Glucose-gelatine stab.—The stab becomes filiform, with a dry, glistening white nail-head, either raised at the margin and depressed in the centre, or flat and spreading. The nail-head eventually becomes crateriform from the consumption of the medium, which is liquefied below the centre of the film. The medium may or may not darken.

Potato.—The growth is yellowish-white, thin, glistening and scattered; it becomes raised, and buff-white and appears gummy or fatty.

Bouillon.—The medium becomes very turbid with a loose flocculent sediment and slight surface ring. The indol reaction was obtained, and in nitrate-bouillon the nitrate was reduced to nitrite.

Milk.—The medium is not affected.

Summary.—The gum of *Sterculia diversifolia* consists of a mixture of arabin and pararabin. The arabin is produced by

Bact. acaciæ. Another organism—*Bact. pararabinum*, n.sp.—was isolated from the gummed fruits, etc. Upon solid media and in solutions containing saccharose, dextrose, levulose, galactose, mannite or glycerine, a slime is formed. By appropriate treatment this yields a soluble pararabin gum which upon dehydration becomes insoluble, and this modification is soluble in dilute acid and insoluble in dilute alkali. It is not hydrolysed by dilute acid, but strong acid converts it into arabinose and galactose. The bacterium does not secrete invertase, and in solutions of saccharose it forms gum, ethyl alcohol, carbon dioxide, succinic, lauric, acetic, butyric and formic acids.

ERRATA.—On p. 119 of these Proceedings, in third line from bottom, *for* 67·08 *read* 64·68; and on p. 348, in line 5, *for* gelatine *read* galactan.

AUSTRALIAN FUNGI, NEW OR UNRECORDED. DECADES V.-VI.

By D. McAlpine, Corresponding Member.

The following Fungi are all new species with the exception of three, and they belong to 15 different genera.

Schizotrichum, a new genus of Hyphomycete, has been constituted to include a form found on the flowering stems of a native Lobelia. Two Rusts are recorded, one on the Marigold and another on *Stipa*. The former was first observed in 1892, but only one stage (*æcidium*) was met with until 1902, and considering the wide range of the Rusts, it is strange that it has not been discovered elsewhere on such a widely distributed cultivated plant.

41. Ascochyta arida, n.sp.

Spots brown, arid, becoming perforated, elliptical to irregular, with slightly raised margins, often confluent and forming irregular patches, with minute, black, punctiform, aggregated pustules. Perithecia golden-brown by transmitted light; depressed globose, erumpent, membranaceous, with round papillate mouth, average 170 μ diam. Sporules pale green collectively, oblong, 1-septate, not constricted at septum, rounded at both ends, sometimes slightly narrower at one end, 2-guttulate, 17-19 × 4-4½ μ.

Swan Hill, Victoria; on languid leaves and dried-up dead shoots of *Nicotiana glauca*, Graham; Oct., 1899. Very common. The shoots were completely dried up, with bark peeling off, and the erumpent perithecia were aggregated here and there in irregular groups.

Ascochyta nicotianæ, Pass., found on the leaves of *Nicotiana tabacum* in Italy, has ovoid-oblong, hyaline sporules, slightly constricted at septum; whereas in this species the sporules are of a pale greenish tint, not constricted at septum, oblong in shape and with a guttule in each cell.

42. CAMAROSPORIUM OLEARIÆ, n.sp.

Perithecia minute, black, punctiform, ultimately superficial, scattered, depressed globose, olivaceous, but dark brown from contained spores, membranaceous, with round slightly papillate mouth, 140-160 μ diam. Sporules numerous, dark brown, fusoid to somewhat oval, 3-4-septate, not constricted at septa, with 1-2 obliquely longitudinal median septa, 14-17 × 7-8 μ.

Port Fairy, Victoria; on branches of *Olearia axillaris*, F.v.M.; May, 1899.

43. FUSARIUM GRACILE, n.sp.

Sporodochia minute, sessile, round to elliptical, gregarious or broadly effused, on pale portion at junction of stem and root, also on root. Conidiophores ruddy in mass, hyaline individually, radiating, septate, not constricted at septa, tapering to a fine point, 120 × 3½ μ. Conidia produced at apex, very abundant, hyaline, crescent-shaped, acute at both ends, 3-5 septate, not constricted at septa, guttulate, average 70 × 2½ μ.

Sandringham, Victoria; on flowering stem of *Lobelia gibbosa*, Labill.; Dec., 1902.

It differs from *F. roseum*, Link, in the slender, graceful conidia, and seems to be quite a characteristic species.

44. HENDERSONIA LOBELIÆ, n.sp.

Perithecia black, punctiform, somewhat gregarious or solitary, slightly erumpent, olive by transmitted light, depressed globose to oval, membranaceous, of parenchymatous texture, with apical pore, 170-210 μ diam. Sporidia clear olivaceous, oblong, rounded at both ends, 3-septate, guttulate at first, generally constricted at median septum and occasionally at other septa as well, 13-17 × 4½-6 μ.

Sandringham, Victoria; on stem and leaves of *Lobelia gibbosa*, Labill.; Dec., 1902.

The spore, even when coloured, may be without septa; then the median septum is formed, next a second septum in one half, and finally the third septum in the other half.

It differs from the common *H. sarmentorum*, West., in the sporules being longer and broader, and olivaceous in colour. It was intermixed with *Pestalozzia citrina*, McAlp.

45. MACROPHOMA BRUNNEA, n.sp.

Perithecia semi-gregarious, dark brown, covered by epidermis, depressed globose, bright yellowish-green by transmitted light; membranaceous, of parenchymatous texture; opening at surface by pore, 200-230 μ. Sporules hyaline, elongated-ellipsoid to fusoid, rounded at both ends, with coarsely granular contents, 21-24 × 5-7 μ; basidia hyaline, elongated, variable in length and breadth, average 14 × 2-3 μ.

Sandringham, Victoria; on stems of *Lobelia gibbosa*, Labill.; Dec., 1902, and Jan., 1903 (C. French, Jr.).

It differs from *M. hueffelii* (B. & C.), Berl. & Vogl., found on the living stems of Lobelia, in which the perithecia are globose and at length free, and the oblong sporules 16-17 μ long. The perithecia are brown in colour when closely inspected, and the apical pore may enlarge considerably owing to the disruption of the surrounding tissue.

46. MASSARINULA PHYLLODIORUM, n.sp.

Spots on both surfaces, numerous, slightly raised, more or less orbicular, often confluent, pallid or light brown, with distinct darker margin. Perithecia few, black, at first immersed, then erumpent, globose, subcarbonaceous, with apical pore, up to ¼ mm. diam. Asci clavate to saccate, subsessile, 8-spored, 120-140 × 30-50 μ. Sporidia distichous or conglobate, colourless, lanceolate, 1-septate and slightly constricted at septum, straight or slightly curved, 54-64 × 13-16 μ. Paraphyses very copious, agglutinated, apparently filiform, broken up into small segments.

Mordialloc, Victoria; on phyllodes of *Acacia longifolia*, Willd.; Sept., 1901 (C. French, Jr.).

The species of this genus are mostly found on bark, but occasionally on leaves. The large and beautiful sporidia are very characteristic.

47. PESTALOZZIA CITRINA, n.sp.

Pustules punctiform, black, convex, covered by epidermis, finally naked, globose or elongated, scattered, ⅓-¼ mm. Conidia fusoid, straight or sometimes curved, 3-4- and occasionally 5-septate, slightly constricted at septa, two or three (or four) median cells lemon-yellow, terminal cells hyaline, conoid, and apical one surmounted by one, two or three diverging slender setæ, straight or curved, reaching a length of 21 μ, and sometimes one at right angles to the other, 24-28 × 7-8½ μ; basidia slender, hyaline, up to 28 × 2 μ.

Sandringham, Victoria; on stem of *Lobelia gibbosa*, Labill.; Dec., 1902 (C. French, Jr.).

In *P. funerea*, Desm., which varies considerably on different hosts, the conidia are dark brown to dark olive, and the basidia are short.

48. PHOMA LOBELIÆ, B. & Br.

Perithecia minute, black, semi-gregarious, at first covered by epidermis then erumpent, lenticular, yellowish-green by transmitted light, membranaceous, fragile, with large papillate mouth, 120-140 × 70-80μ; mouth 28μ diam., mycelium giving rise to perithecia composed of pale olivaceous, elongated, septate hyphæ 6-7μ broad. Sporules hyaline, elliptical, biguttulate, 3½-4½ × 1½-2μ.

Sandringham, Victoria; on stems of flowering *Lobelia gibbosa*, Labill.; Dec., 1902 (C. French, Jr.).

This species was first found on *Lobelia nicotianæfolia*, Heyne, in Ceylon. The original description is very brief, but the sporules agree in both the Ceylon and Victorian specimens.

49. PHYLLOSTICTA CORREÆ, n.sp.

Epiphyllous. Spots marginal, elongated, brown, with distinct dark-coloured border. Perithecia black, slightly erumpent, scattered, dark brown by transmitted light, depressed globose, membranaceous, with papillate pore, 180-210 μ diam. Sporules numerous, hyaline, guttulate, cylindrical or tapering towards attached end; 7-9 × 2-3 μ; basidia arising from olivaceous base, hyaline, filiform, 9-10 μ long.

Sandringham, Victoria; on languishing leaves of *Correa speciosa*, Ait.; Jan., 1903.

50. PHYLLOSTICTA PASSIFLORÆ, n.sp.

Perithecia on large fawn irregular patches which ultimately become perforated; black, punctiform, scattered or subgregarious, immersed, depressed globose, membranaceous, with papillate apical pore, 200-220 μ diam. Sporules numerous, greenish in mass, hyaline individually, minute, bacilliform, 3 μ long.

Malvern, Victoria; on leaves of *Passiflora edulis*, Sims; March, 1903.

The fawn patches are very conspicuous, and the immersed, black, dot-like perithecia are easily seen upon the pale background. It differs from *Phoma tersa*, Sacc., found on dry fruits, in which the sporules are 6 × 2½ μ; and from *Phoma passifloræ*, Penz. & Sacc., on dry flower-stalks, in which the sporules are 7-8 × 3-3½ μ.

51. PROSTHEMIUM KENTIÆ, n.sp.

Spots numerous, dark brown to black, on both surfaces of leaf, orbicular to oblong, definitely circumscribed, up to ½ cm. diam. Perithecia scattered or several together, minute, olivaceous, globose, immersed, membranaceous, ultimately raising and rupturing epidermis, 100-140 μ diam. Sporules pale olivaceous in mass, hyaline individually, 3-5-radiate and springing from short basal stalk, usually elongated-obclavate, septate (4-5), variable in length, 25-45 × 3 μ.

Brighton, Victoria; on leaves of *Kentia Forsteriana*, F.v.M.; Feb., 1903.

Only four species of this genus have been recorded—three in Europe and one in America—and these have all coloured spores. In this case the stellately-arranged sporules are hyaline individually, but it is still retained in that genus.

52. PUCCINIA CALENDULÆ, n.sp.

i. Aecidia orange-yellow, in clusters, crowded, sometimes circinate, 320-360 μ diam.; pseudoperidia with margin torn and reflexed; peridial cells quadrate or polygonal, striated at margin, 21-24 μ long. Aecidiospores very irregular, subglobose to polygonal, very finely echinulate, pale orange, 14-17 × 11-12 μ.

iii. Teleutosori intermixed with aecidia, black, erumpent, soon naked, girt by the ruptured epidermis, circular to elliptical, compact, often confluent. Teleutospores yellowish-brown, clavate, constricted at septum, thickened at apex, rounded or acute, epispore smooth, 36-52 × 19-23 μ; upper cell darker in colour and broader than lower, 21-31 μ long. and sometimes thickened to a depth of 12 μ; lower cell slightly or not at all tapering towards pedicel, and averaging same length as upper; pedicel hyaline, persistent, 28-37 × 7-8 μ, may attain a breadth of 10 μ at junction with spore.

x. Mesospores not uncommon, similarly coloured to teleutospores, elliptical to pear-shaped, thickened at apex, 30-42 × 21-23 μ.

Armadale, Victoria; 1892, 1902 and 1903 (Robinson) on upper and under surface of leaves and all green parts, including fruits, of *Calendula officinalis*, L.; Killara, Oct., 1902.

Aecidium-stage all the year round, but less common in midsummer. Teleuto-stage from March to June. The aecidium-stage was the only one found at first, and was described in the Agricultural Gazette of New South Wales, 1896, p. 152. Then in March, 1902, the teleuto-stage was found by Mr. G. H. Robinson, and was very plentiful this season. It causes swelling, distortion, and discoloration of the flower-stems and leaves, and the bright orange colour of the aecidia on the leaves readily attracts attention from its harmonising with the flower-head.

53. PUCCINIA FLAVESCENS, n.sp.

ii. Uredosori on upper surface of leaf, minute, linear, often confluent, soon naked, pulverulent, rusty brown, arranged along furrows of leaf. Uredospores globose to shortly elliptical, finely echinulate, golden-brown, with at least 5 germ-pores irregularly distributed, 21-24 μ diam., or 25-28 × 21-24 μ.

iii. Teleutosori minute, elliptical, numerous, black, often confluent lengthwise, soon naked. Teleutospores intermixed with uredospores, dark chestnut-brown, oblong, constricted at septum, with rounded and thickened apex, smooth, 33-48 × 18-24 μ; upper cell generally hemispherical, and about equal in length to lower; lower cell generally rounded at base, sometimes narrow and elongated like upper portion of pedicel; pedicel persistent, tinted, elongated, up to 72 μ long.

Hampton, Victoria; on *Stipa flavescens*, Labill.; Jan., 1903.

The pulverulent uredosori, and the numerous minute, black teleutosori are characteristic of this species. The uredospores form a rusty powder over entire upper surface of leaf. The pedicel of the teleutospore is sometimes lateral and the septum erect as in *Diorchidium.* It differs from *P. stipæ*, Arthur, in the uredosori being soon naked and decidedly ruddy-brown, not yellowish, while the uredospores are broader.

In specimens of *P. stipæ*, (Op.) Hora, taken from Syd. Ured. Exs. No. 28, on *Stipa capillata*, L., the teleutospores are decidedly different. The apex is generally bluntly pointed, and the size 48-54 × 18-21 μ. In specimens of *P. stipæ*, Arth., from Arthur and Holway's Ured. Exs. No. 27, on *Stipa spartea*, Trin., the teleutospores are more pointed at the apex and rather thicker.

I have submitted specimens to Prof. J. C. Arthur, and he remarks that it is clearly distinct from his species, although there is very much similarity between the two, as one might expect, from the hosts being essentially alike.

54. RHABDOSPORA LOBELIÆ, n.sp.

Perithecia black, punctiform, gregarious, erumpent, on greyish epidermis, globose, dark brown by transmitted light; membranaceous, rather firm, with papillate mouth, 160-200 μ diam. Sporules numerous, hyaline, filiform, straight or slightly curved, rounded at both ends, or rather acute, 1- or more guttulate, with granular contents, 24-31 × 3-3½ μ, average 28 × 3 μ; basidia very slender, curved, 7-10 μ long.

Sandringham, Victoria; on stems of *Lobelia gibbosa*, Labill.; Jan., 1903.

It differs from *Septoria lobeliæ*, Peck, in the absence of spots, and the sporules there are 17-25 μ long. Also from *R. campanulæ*, Fautr., in which the sporules are 40-60 × 2 μ.

55. SEPTORIA AUSTRALIÆ, n.sp.

Spots on both surfaces, orbicular to irregular, at first ruddy-brown and indefinite, then definite with milk-white centre and dark brown margin. Perithecia black, crowded, punctiform, slightly erumpent, lenticular, membranaceous, with round papillate apical pore, 80-100 × 120-140 μ. Sporules hyaline, straight, curved or flexuous, very slender, generally 3-septate, 30-45 × 0·75-1 μ, average 35-40 μ in length.

Kiewa Valley, Victoria; on *Viola betonicifolia*, Sm.; Nov., 1902 (Robinson).

This is a very distinct species, and differs from the others found on *Viola* as follows:—In *S. violæ*, West., the perithecia are epiphyllous, and the spores are 20-30 × 1 μ. In *S. violicola*, Sacc., the perithecia are also epiphyllous, and the spores are comparatively stout, being 24 × 7-8 μ. In *S. hyalina*, Ell. & Ev., the white spots have a purple margin, and the non-septate spores are 20-40 × 1 μ.

56. SEPTORIA CONFLUENS, n.sp.

Spots greyish-white to grey, and occupying large portions of leaf, or without distinct spots. Perithecia black, crowded, and often confluent, globose to lenticular, dark brown by transmitted light, membranaceous, fragile, with apical pore, 140-175 μ. Sporules hyaline, straight, sinuous or curved, 2-3 septate, generally 2-septate, not constricted at septa, rounded at both ends, or somewhat pointed at one or both ends, with granular contents, average 52-56 × 3½-4 μ, but may vary in length from 42 to 63 μ.

Sandringham, Victoria; on fading and faded leaves of *Mesembryanthemum æquilaterale*, Haw.; Oct., 1902.

57. SEPTORIA LAGENOPHORÆ, n.sp.

Spots more or less orbicular, on both surfaces of leaf, dirty fawn to dirty brown, distinct, and from 3-8 mm. in diam. Perithecia minute, innate, subgregarious, black, olivaceous by transmitted light, depressed globose, delicately membranaceous, with distinct round papillate mouth, 80-100 μ diam. Sporules hyaline, filiform, straight, curved or flexuous, apparently 1-2 septate, very slender, 19-24 μ long, average 21 μ.

Kiewa Valley, Victoria; on living leaves of *Lagenophora billardieri*, Cass.; Nov., 1902 (Robinson).

It differs from *S. sonchi*, Sacc., in the distinct spots, and the slightly smaller perithecia, as well as in the sporules being much more slender. The apparent clear septa may be guttules which occupy the entire breadth of the narrow sporules. *Puccinia lagenophoræ*, Cooke, both in its aecidial and teleuto-form may occur on both surfaces of the spot, which, however, is primarily caused by the *Septoria*.

58. SEPTORIA VARIA, n.sp.

Spots dry, brown or grey, rather indefinite, sometimes defined by a black line. Perithecia minute, black, immersed, membranaceous, globose to lenticular, with protruding papillate mouth, 80-130 μ. Sporules hyaline, filiform, straight or curved, at first continuous, then at maturity distinctly 3-septate, issuing in tendrils when moist, 35-45 × 1-1½ μ.

Myrniong, Victoria; on leaves of *Plantago varia*, R.Br., Aug., 1900; Jackson Creek, Oct., 1900 (C. French, Jr.); Kiewa Valley, Nov., 1902 (Robinson).

There are various species of this genus found on *Plantago*, but they differ from the above. *S. heterochroa*, Desm., has spores 25 μ long. *S. inconspicua*, B.C., has spores 55 × 2½ μ. *S. plantaginis*, Sacc., has filiform-clavate spores, and those of *S. plantaginea*, Pass., are pluri-septate and 55 × 2½ μ. In *S. vanhoeffenii*, Henn., the spores are only 15-21 × 2-2½ μ.

SCHIZOTRICHUM, n.g.

Sporodochia globose or subglobose, erumpent, ultimately superficial, black; setæ septate, thick-walled, erect, straight or slightly curved, few or numerous. Conidiophores obsolete or represented by a minute colourless base. Conidia hyaline, filiform, straight or curved, 3- or more septate.

This genus has a dark-coloured sporodochium, but the conidia are hyaline, hence it belongs to the Series *Tubercularieæ mucedineæ*, Sacc. Further, on account of the septate spores, it will occupy a place beside *Leptotrichum*, Corda, in which the conidia are only 1-septate and the setæ continuous.

59. SCHIZOTRICHUM LOBELIÆ, n.sp.

Sporodochia on sooty elongated patches, densly crowded, globose or discoid, erumpent, finally superficial, black, with greyish bloom due to conidia, 130-160 μ diam., composed of compact dark olivaceous, closely septate and copiously branched hyphæ 7-9 μ broad; with similarly coloured, projecting, thick-walled setæ, simple, septate, not constricted at septa, with usually rounded and almost colourless apex, 70-95 × 4½-5 μ. Conidiophores obsolete. Conidia hyaline, filiform, straight or curved, 3-6-septate, not constricted at septa, guttulate, very variable in length, average 28-35 × 1-2 μ, but may reach a length of 50-60 μ.

Sandringham, Victoria; on flowering and fruiting stems as well as leaves of *Lobelia gibbosa*, Labill.; Dec., 1902; Jan., 1903.

The black elongated patches are very conspicuous and often very numerous. The sooty appearance is due to a perfect network of dense olivaceous hyphæ which connect the various sporodochia. The conidia arise direct from the olive-coloured cells of the sporodochium, or there may be a minute, basal, hyaline cell from which the conidia are detached. The radiating setæ may be few or numerous, sometimes none or apparently covering the entire sporodochium, and very occasionally the apex gives rise to a colourless filament, resembling a conidium originating from the basal cells.

60. SEYNESIA BANKSIÆ, Henn.

Spots epiphyllous, brownish, roundish to indefinite, often confluent, particularly along midrib. Perithecia gregarious, scutiform, radiate-cellular, black, with central irregular pore, 160-220 μ diam. Asci ovoid to clavate or cylindric-clavate, rounded at apex, ending abruptly at base or with very short pedicel, 8-spored, variable in size, 40-65 x 16-25 μ. Sporidia distichous or conglobate, subellipsoid to ovoid, brown, 1-septate, constricted at septum, upper cell stouter, 15-19 x 7·9 μ. Paraphyses crowded, filiform, hyaline, much branched.

Dimboola Desert, Vic.; on leaves of *Banksia ornata*, F.v.M., Aug., 1896 (Reader): Gosford, N.S.W.; on leaves of *Banksia* sp., April, 1902 (Pritzel): Eumundi, Q., May, 1902 (Pritzel).

This species had just been described and named as above when I received 'Hedwigia' (xlii., Part 2) for March, 1903, in which Prof. P. Hennings had described this one along with other Australian Fungi. The descriptions are substantially the same, only the paraphyses were overlooked by Prof. Hennings.

NOTES AND EXHIBITS.

Mr. Froggatt showed specimens of a small beetle (Fam. *Hispidæ*) received from Mr. J. H. Maiden, to whom they had been forwarded by the Manager of a large plantation in New Britain, with the information that the larvæ were destroying the fronds and buds of the cocoanut palms in a very serious manner.

Dr. Greig Smith exhibited cultures and products obtained during the investigation of Sterculia gum. Also the cork from a sample bottle of a quantity of deteriorated wine, showing extensive damage due to the borings of insect larvæ.

Mr. Steel exhibited a specimen from one of the prehistoric so-called "Vitrified Forts" occurring in Scotland, and gave an account of these remarkable relics (for a detailed account with bibliography, see Encyclop. Brit., 9th Ed., Vol. xxiv., p. 263).

Mr. H. S. Mort exhibited a specimen of *Dimya corrugata*, Hedley, from Long Bay. The species was described from material obtained during the "Thetis" Expedition, and is only the second recent species of the genus.

Mr. Fred Turner exhibited specimens of *Chenopodium rhadistachyum*, F.v.M., a rather uncommon Chenopod from Roebourne, W.A.: and *Tecoma Hillii*, F.v.M., one of the rarest of Australian plants, and the most beautiful of the Australian *Bignoniaceæ;* one plant was found by the exhibitor at Harvey Bay in 1876; and in Part iv. of the recently published "Queensland Flora" Mr. F. M. Bailey reports that no other plant in the wild state had since been discovered.

Professor David showed a series of rock specimens, fossils, rock sections under microscopes, and lantern slides, in illustration of Mr. Woolnough's paper.

WEDNESDAY, AUGUST 29TH, 1903.

The Ordinary Monthly Meeting of the Society was held in the Linnean Hall, Ithaca Road, Elizabeth Bay, on Wednesday evening, August 29th, 1903.

Dr. T. Storie Dixson, President, in the Chair.

The President said that, as Members were aware, in the interval since the last Meeting, Lady Macleay, the widow of the Founder and Benefactor of the Society, had passed to her rest after a brief illness. Lady Macleay's sustained interest in the welfare of the Society, and in the other plans for the advancement of science inaugurated by her husband, Sir William Macleay, was a source of gratification to the Society. The Council, on behalf of the Society, had already found occasion to give expression to the profound regret which Lady Macleay's decease had evoked; and also to respectfully tender sincere sympathy to Mr. E. Deas Thomson and the members of the family.

The Donations and Exchanges received since the previous Monthly Meeting, amounting to 13 Vols., 59 Parts or Nos., 4 Bulletins, 3 Reports, 2 Miscellanea, and 11 Maps, received from 52 Societies, &c., were laid upon the table.

STUDIES IN AUSTRALIAN ENTOMOLOGY.

No. XII. New Carabidæ (*Panageini*, *Bembidiini*, *Pogonini*, *Platysmatini*, *Platynini*, *Lebiini*, with Revisional Lists of Genera and Speecis, some Notes on Synonymy, &c.).

By Thomas G. Sloane.

Tribe PANAGEINI.

Baron de Chaudoir monographed the *Panageini* of the globe in 1878,* his essay including a table of the genera, which shows three as Australian. These genera may, from Chaudoir's table, be arranged thus :—

Paraglossæ extending beyond the ligula and prolonged in a more or less narrow and long lobe.
  Tooth of mentum broad and truncate.......................... *Epicosmus.*
  Tooth of mentum narrow, rather elongate. (Mandibles long and prominent, elytral spots blood red)...... ... *Tinognathus.*
Paraglossæ not extending past the ligula, and only appended to its lateral margins. (Labrum emarginate, the two piliferous punctures of the middle very near the anterior margin)................. .... *Trichisia.*

Genus Epicosmus.

In my study of this genus I have had to make out Castelnau and Chaudoir's species from the descriptions; it is, therefore, necessary for me to support my references to species of these authors by descriptive notes on the species to which I apply names given by them. This is more necessary because I find that I cannot follow Chaudoir in his treatment of Castelnau's species.

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* Ann. Soc. Ent. Belg. xxxi., 1878.

All the Australian species have the pronotum and the lateral parts of the underside (including prosternum and mesosternum) covered with large punctures; also in a general way all these punctures are setigerous: the ventral segments have the anterior margins crenulate-punctate.

Chaudoir says that in *Epicosmus* the apical joint of the palps has the form of a triangle with the sides almost equal, broader in ♂ than in ♀; but I do not find this sexual character sufficiently distinctive to be of much use, for these joints are so compressed that their apparent width varies according to the point of view from which they are observed. I infer from Chaudoir's treatment of the Australian species that he considered the shape of the prothorax the same in both sexes; but this does not seem to be the case, my observations going to support the view that in ♂ the prothorax is narrower (often decidedly so), particularly at the base, and often has the posterior part of the sides more strongly sinuate than in ♀. *E. australis*, Dej., is unknown to me in nature.

According to Chaudoir, all the species of the genus *Epicosmus* have yellowish spots on the elytra. This indicates that the spots are of some advantage to these insects; probably they are of a protective nature to warn insect-feeders against them, for they emit an acrid fluid with a most searching and pungent odour, which suggests that they must be anything but dainty articles of diet. Our species are found in dry forest lands, and not about damp places or marshes.

Table of Species.

Prothorax with basal angles rounded, not dentate. (Elytra very wide and convex)........................ { *E. insignis*, Schaum. / *E. macleayi*, Sl.

Prothorax with basal angles sharply marked and dentate.

Elytra with at least third, fifth and seventh interstices forming strongly raised ridges, with summits nitid and not, or hardly punctate.

Elytral interstices subequal, third, fifth and seventh not decidedly more raised than fourth and sixth in middle. (Form stout, elytral spots orange).

Inflexed margins of elytra black.............. ....*E. obesulus*, Sl.

Inflexed margins of elytra with a reddish mark towards base (beneath anterior spot of upper surface).

Prothorax with posterior lateral sinuosity obsolete, or almost so. ....*E. rockhamptonensis*, Casteln.
Prothorax with sides strongly sinuate posteriorly. *E. comptus*, Laf.
Elytra with third, fifth and seventh interstices much more raised than fourth and sixth.
Form short, oval, convex.
Two inner interstices of each elytron not placed in a wide deep sutural channel........................ ....*E. froggatti*, Sl.
Third interstice of elytra very strongly raised so that the sutural space between them forms a wide channel ...*E. australasiæ*, Chaud.
Form oblong.
Prothorax decidedly broader than long.
Elytra convex, oval, with sides rounded; elytral spots orange, round, anterior distant from base................*E. alternans*, Casteln.
Elytra depressed, oval, with sides parallel; elytral spots red, anterior large and near base..................... ....*E. mastersi*, Sl.
Prothorax hardly broader than long; elytral spots red...................................... { *E. elongatus*, Casteln. / *E. australis*, Dej.
Elytral interstices roundly convex, equal and punctulate. (Length 9·5 mm.)... ....*E. parvulus*, Macl.

EPICOSMUS MACLEAYI, n.sp.

Eudema nobile, Macl., Proc. Linn. Soc. N.S.W. 1888 (2), iii., p. 462.

Chaudoir, in his Monograph, refers *Panageus nobilis*, Dej., to *Epicosmus;* Macleay's name *E. nobilis*, therefore, requires changing. It is closely allied to *E. insignis*, Schaum, but differing by prothorax proportionately longer (4·2 × 5—*insignis* 4·2 × 5·8 mm.), much narrower at apex (2·4—*insignis* 3·1 mm.), of same width at base (3·4 mm.); sides less ampliate; widest part placed further back; margins less explanate and not the least sinuate towards base, &c. Length 16·5, breadth 7·7 mm. (*E. insignis* 18 × 8·5 mm.).

Hab.—N.W.A.: Behn River (Helms).

EPICOSMUS OBESULUS, n.sp.

Robust, oval, convex. Black; elytra with four orange-coloured spots; anterior spot small, transverse, distant from base; inflexed margins black (not marked with a red spot near base). Allied to *E. rockhamptonensis*, Casteln.; head not differing. Prothorax small, transverse (2·7 × 3·5 mm.), widest just behind middle, convex, strongly declivous to anterior part of sides and gently so in a long slope to middle of base; sides ampliate, rounded at widest part, strongly and roundly narrowed to apex (1·9 mm.), strongly narrowed to base (2·6 mm.); posterior part of sides rather sharply upturned, appearing lightly and widely sinuate if viewed from side, oblique (hardly rounded) if viewed across disc; anterior angles close to head, not marked; basal angles feebly dentate, the tooth very small and less prominent than the margin before the deeply marked juxta-basal notch; a wide shallow depression on each side of base; median line distinct; lateral margins anteriorly not (or very narrowly) explanate. Elytra short, wide (6·5 × 4·6 mm.); base wide; sides rounded, interstices 2-7 almost equal, third more prominent posteriorly. Length 10·5-12·5, breadth 4·6-5·25 mm.

Hab.—Q.: Townsville (Dodd).

I received two specimens from Mr. F. P. Dodd, of Townsville, taken near that town; the smaller (♂) has served me for the measurements given above. Closely allied to *E. rockhamptonensis*, Castln. (as identified by me, *post*), of which it may be a variety, but I prefer to distinguish it under a separate name because of the following differences:—Elytral spots (particularly the anterior) smaller; inflexed margins without a reddish mark below the anterior elytral spot; form more convex, prothorax shorter, more convex; elytra more convex (declivous to scutellum), more declivous to sides, which are more rounded. Its elytra do not agree with Chaudoir's description of those of *E. corpulentus*, therefore I have been unable to consider it that species.

EPICOSMUS ROCKHAMPTONENSIS, Castelnau.

Eudema rockhamptonense, Casteln., Trans. Roy. Soc. Vict. viii. 1868, p. 146: ***Epicosmus corpulentus***, Chaud., Mon. p. 131.

♀. Oval, robust. Black; elytra with four orange-coloured spots, the anterior spot distant from base; inflexed margins with a reddish mark near margin below anterior elytral spot. Prothorax transverse (3·5 × 4·65 mm.), subconvex; apex narrow (2·1 mm.), lightly emarginate; anterior angles obtusely rounded; sides ampliate in middle, widely rounded at widest part, strongly and roundly narrowed to apex, less strongly narrowed to base (3·25 mm.), posterior part widely subsinuate if viewed from side, rather rounded if viewed across disc; a wide shallow depression on each side of base; margins lightly raised from these basal depressions. Elytra wide, oval (9 × 6 mm.); sides lightly rounded; apex sinuate on each side; interstices 2-7 almost equal in size and convexity, summits nitid and impunctate, 3rd and 5th a little larger than others, 3rd more prominent posteriorly. Length 14, breadth 6 mm.

♂. Smaller; prothorax less transverse (3·25 × 4 mm.), narrower at base (2·8 mm.); posterior part of sides more upturned, more sinuate when viewed from side; elytra similar (7·7 × 5·5 mm.), less rounded on sides, summits of interstices narrower. Length 12·5-13, breadth 5·2-5·5 mm.

Hab.—Q.: Rockhampton (*fide* Castelnau and Chaudoir), Burnett River District (Coll. Sloane).

I have no hesitation in referring my largest specimen (♀) to *E. rockhamptonensis*, Casteln., and the smaller specimens (♂) agree with Chaudoir's note on his *E. corpulentus*. I therefore regard these two species as the same. The essential difference from *E. comptus*, Laf., is in the shape of the prothorax which is less strongly narrowed to the base, and much less sinuate on the posterior parts of the sides.

Note.—My specimens (five in number) were brought back by Professor W. Baldwin Spencer from a trip to Gayndah and the Burnett River in 1892. Amongst the specimens obtained by Professor Spencer were two small ones (length 10·5-11·5 mm.) with the prothorax almost as in *E. australasiæ*, Chaud., *i.e.*, more convex than in *E. rockhamptonensis* and more declivous anteriorly; the elytra do not differ noticeably from *E. rockhamptonensis*, of which it seems a small form or variety.

EPICOSMUS COMPTUS, Laferté.

Isotarsus comptus, Laf., Ann. Soc. Ent. France, 1851, p. 220; Chaud., Mon. p. 130: *Eudema australe*, Casteln. (not Dejean), *l.c.*, p. 146.

Black; elytral spots orange; inflexed margins of elytra reddish below anterior spot. Prothorax broader than long (2·9 × 3·6 mm.), ampliate at widest part; sides obliquely but a little roundly narrowed to apex (2 mm.), strongly narrowed to base (2·35 mm.), posterior part of sides strongly sinuate. Elytra oval (7·1 × 4·8 mm.), lightly convex; interstices 2-7 subequal behind posthumeral spots, summits nitid, 3rd, 5th and 7th visibly more raised towards base, 3rd strongly raised on apical declivity. Length 12·3, breadth 4·8 mm.

Hab.—South of Queensland, and north of New South Wales (*fide* Castelnau).

My single specimen is without locality. Castelnau says it is found in South Queensland, Clarence River, Sydney, &c. I have, however, only found *E. mastersi*, Sloane, in the neighbourhood of Sydney. Chaudoir in his 'Monograph' says that *Eudema australe* of Castelnau's notes was *E. comptus*, Laf.

EPICOSMUS FROGGATTI, n.sp.

Oval, robust, convex. Head small; prothorax with disc roundly convex in middle, declivous to apex and sides, and to base in a long but decided slope, margins reflexed near base; elytra convex, sutural part (1st and 2nd interstices) lightly depressed, striæ deep, punctate, interstices very convex, rounded on summits, 3rd and 5th a little wider and more raised, with summits more nitid and hardly punctulate. Black; elytral spots dark red, large (anterior 1·7, posterior 1·6 mm. in length).

Head long, convex; eyes small, hemispherical; antennæ slender. Prothorax transverse (2·3 × 3·25 mm.), widest just behind middle; sides roundly ampliate from apex, strongly and widely rounded at widest part, rather obliquely narrowed to base without sinuosity; base (2·1 mm.) wider than apex (1·6 mm.); basal angles sharp, shortly dentate; anterior angles obtuse, not marked, margin narrowly and very lightly flattened at widest part, strongly reflexed posteriorly; border forming a narrow rim on sides to behind widest part, then merged with edge. Elytra oval (6·2 × 4·1 mm.), convex; apex lightly and widely sinuate on each side; interstices convex, summits punctulate, the puncturation weaker towards base and on third and fifth interstices. Length 10, breadth 4·1 mm.

Hab.—W.A.: Kalgoorlie (G. W. Froggatt; Coll. Sloane, given to me by Mr. W. W. Froggatt).

Allied to *E. australasiæ*, Chaud., but at once distinguishable from it by the 3rd interstice of the elytra less raised into a carina, particularly on apical declivity; head decidedly narrower; eyes smaller; antennæ more slender; maxillary palps more slender (penultimate joint especially longer and more slender); prothorax almost similar in shape and sculpture, more convex, more declivous from middle of disc, especially to posterior part of sides and base; sides more strongly rounded on anterior part; anterior angles less marked; elytra similar in shape and pattern, but different by interstices less raised (particularly the 3rd and 5th), more punctulate; the 3rd interstice though raised has its summit rounded, and does not form a strong carina posteriorly, consequently the elytra have not the marked wide sutural channel of *E. australasiæ*, though the 1st and 2nd interstices are a little depressed.

EPICOSMUS ALTERNANS, Castelnau.

Eudema alternans, Casteln., *l.c.* p. 146.

Elliptical-oval, lightly convex. Black; elytral spots orange, a little distant from base; inflexed margin of elytra with an obscure reddish mark below anterior spot.

♂. Prothorax broader than long (3·9 × 4·5 mm.); margins narrowly explanate near anterior part of sides; anterior angles widely rounded, a little advanced; sides lightly rounded at widest part, subobliquely narrowed to apex (2·5 mm.), strongly and sinuately narrowed to base (3·1 mm.) Elytra oval (9·7 × 6·2 mm.);

3rd, 5th and 7th interstices more strongly raised, 3rd forming a strong ridge posteriorly; 1st and 2nd convex, punctulate, 4th and 6th lightly convex, summits rounded, punctulate. Length, ♂ 16, ♀ 17; breadth, ♂ 6·2, ♀ 7 mm.

Hab.—Q.: Rockhampton (*fide* Castelnau), Burnett River District (Spencer; Coll. Sloane)—N.S.W.: Glen Innes (Sloane).

My specimen (♂) from the Burnett River has been used for the description given above. A second specimen (♀ without locality) is in my collection; it has the prothorax much wider (4·2 × 5·1 mm.), much wider at base (3·5 mm.), sides less strongly narrowed and less sinuate posteriorly, lateral margins more explanate. A specimen (♂) which I took at Glen Innes has the same measurements as the ♂ described above, but is a little more depressed, with the elytral spots darker, though not such a dark red as in *E. mastersi*, Sl.

I feel no doubt of the identity of this species, but it is not the species Chaudoir noted as *E. alternans* in his 'Monograph'; he seems to have overlooked the fact that Castelnau, in a note appended to the description of *E. rockhamptonensis*, said the elytral spots of his *E. alternans* and *E. rockhamptonensis* were orange, for in the 'Monograph' the name *E. alternans* is attached to a species with red elytral spots. Some confusion seems to have occurred in Castelnau's paper in regard to the size of these two species, where *E. rockhamptonensis*, 7 lines in length, is said to be smaller than *E. alternans;* but the size of *E. alternans* is given as 7 lines (probably it should read 7½ lines); this evidently helped to mislead Chaudoir, for his *E. alternans* is too small. (Length 13·5-14 mm.).

EPICOSMUS MASTERSI, n.sp.

Elliptical-oval. Prothorax depressed (♀ with disc more convex in middle and more declivous to sides than ♂), strongly and a little sinuately angustate to base, much wider at base than apex; elytra depressed between 5th interstices (more convex in ♂ than in ♀), 3rd, 5th and 7th interstices more raised than the others (but 4th and 6th costate), 3rd forming a strongly raised costa with rounded summit posteriorly. Black; elytral spots red, large; inflexed margin of elytra with a red mark below anterior spot.

♂. Head stout, convex; frontal impressions punctate; lateral ridges almost parallel; antennæ elongate. Prothorax broader than long (3·1 x 3·9 mm.), widest just behind middle, not convexly raised in middle of disc, but lightly declivous to sides anteriorly; margins a little flattened at widest part, narrowly so anteriorly, widely upturned posteriorly; anterior angles wide, rounded; sides widely but strongly rounded at widest part, strongly subobliquely narrowed to apex (2·15 mm.), posterior part appearing widely sinuate when viewed from side; base truncate (2·8 mm.); basal angles shortly dentate; median line strongly impressed; a wide shallow concavity on each side of base. Elytra oval (8 x 5·3 mm.), subparallel on sides, sinuate on each side of apex, depressed on disc; interstices 2-7 strongly raised with summits nitid (only 1st, 8th and 9th noticeably punctate). Length 13·3 mm. (*Hab.*—Sydney).

♀. More convex (both prothorax and elytra); prothorax wider, sides less strongly curved at widest part, base wider. Length 14·3, prothorax 3·3 × 4·2, apex 2·25, base 3, elytra 8·5 × 5·7 mm.

Length 12·5-14·3, breadth 5-5·8 mm.

Hab.—N.S.W.: Neighbourhood of Sydney (Auburn and Homebush), Narrara (Sloane).

This seems to be the species Chaudoir regarded as *E. alternans*, Casteln.; but, if so, his identification was erroneous. It is allied to *E. alternans*, but differs by size smaller; form more depressed; spots of elytra of a darker colour, anterior spot larger; head with lateral ridges less divergent anteriorly; (prothorax very similar); elytra more depressed; interstices less unequal, 4th and 6th more carinate. From the species which I regard as *E. elongatus*, Casteln., it differs by form less elongate; prothorax shorter and broader, less strongly sinuate posteriorly; and by the features mentioned above as distinguishing it from *E. alternans*. The elytra are coloured like those of *E. australasiæ*, Chaud., but the anterior spot does not approach so nearly to the base. *E. mastersi* is larger, more depressed; prothorax less convex, less ampliate; elytra much less convex, less rounded on sides, 3rd and 5th interstices much less strongly raised.

Note.—Attention may be drawn to the angustate posterior part of the sides of the prothorax; if viewed from a point above, and a little to the side of the insect these appear sinuate, but, if from the opposite side, across the disc, do not show any sinuosity; the same thing may be observed in some other species.

EPICOSMUS ELONGATUS, Castelnau.

Eudema elongatum, Casteln., *l.c.* 146: *Epicosmus longicollis*, Chaud., Mon. p. 132 (Note).

Closely allied to *E. alternans*, Casteln., and only appearing to differ by elytral spots redder; form narrower; prothorax narrower (3·5 × 3·8 mm.), more obliquely narrowed to apex, posterior part of sides far more strongly sinuate, basal angles less strongly dentate, base narrower (2·6 mm.); elytra similar, but less rounded on sides (9·2 × 5·5 mm.). Length 15·5 mm.

Hab.—N.S.W.: Richmond River (Helms).

For differences from *E. australis*, Dej., *vide* Chaudoir's note. This seems to be *E. longicollis*, Chaud. It also agrees so well with Castelnau's description of *E. elongatus* that I think it must be considered to be that species. The evident agreement of the species before me with Castelnau's description of *E. elongatus*, and the fact that Castelnau's measurement ("Length 7½′") is too large for *E. australis*, Dej., (Length 12-13 mm. according to Chaudoir) induce me to think *E. elongatus* must differ from *E. australis*, though placed under that species by Chaudoir, but without any reasons being given in support of their identity.

Tribe **BEMBIDIINI.**

Genus CILLENUM.

CILLENUM ALBOVIRENS, n.sp.

Elliptical-oval, rather robust; head shagreened, large (1·2 mm. across eyes), eyes prominent; prothorax finely shagreened, truncate-cordate, narrower across base than apex; elytra shagreened, oval, fully and strongly striate, 3rd interstice 2-punctate. Head green, mandibles testaceous-brown, piceous at tips; prothorax testaceous, subviridescent on depressed basal part; elytra virescent (subtestaceous overspread with green); legs and palpi pallid; antennæ dark, with the three basal joints testaceous.

Head depressed between eyes; front rather convex in middle, with a wide shallow impression on each side. Labrum green bordered with brown on each side, sexsetose—the outer seta on each side very long and rising from a large puncture. Prothorax cordate (1 × 1·3 mm.), convex, declivous to base; sides strongly rounded, strongly sinuate posteriorly and meeting base at right angles; anterior angles marked, subprominent; base truncate; basal angles rectangular, acute; basal area narrow, depressed, defined by a transverse arcuate impression; border narrow, even, strongly reflexed. Elytra oval (2·6 × 1·75 mm.); base emarginate behind peduncle, roundly advanced on each side, shoulders obtuse (subangustate); striæ entire, 5th joining lateral channel at shoulders; interstices subconvex, 1st with a well marked striole at base, 2nd wide at apex, 9th not placed in the marginal channel, narrow, rather convex, with a few widely placed setigerous punctures near base and apex; border narrow, reflexed; lateral channel very narrow, a little wider at beginning of apical curve. Length 4·2-4·7, breadth 1·6-1·75 mm.

Hab.—Q.: Townsville (Dodd; Coll. Sloane).

Differs conspicuously from *C.* (*Bembidium*) *mastersi*, Sl., the only other described Australian species, by colour, facies, etc.; eyes much more prominent; prothorax much more narrowed to base and more strongly rounded on sides; elytra less convex, more oval (sides more strongly rounded), base more emarginate, shoulders more advanced and less angulate: the whole upper surface more strongly shagreened.

Genus TACHYS.

T. (BEMBIDIUM) AMPLIPENNIS, Macl.

I have examined the type in the Australian Museum. I would refer it to *Tachys*, and place it according to the tabulation formerly given by me (These Proceedings 1896, xxi. Pt. 3, pp. 356-359) with *T. ectromioides*, Sl. It has the prothorax with a submarginal lateral carina near base; elytra fully striate, with interstices convex, lævigate (neither punctate nor shagreened); apex without a recurved striole. I would tabulate the three Australian species of *Tachys*, known to me, with the prothorax having a submarginal carina near the base, thus* :—

Upper surface finely punctulate. (Elytra with a well marked apical striole) .... *T. brunnipennis*, Macl.
Upper surface impunctate.
  Elytra unicolorous, interstices convex, lævigate... *T. amplipennis*, Macl.
  Elytra bicolorous, interstices depressed, shagreened *T. ectromioides*, Sl.

T. (BEMBIDIUM) SEXSTRIATUS, Macl.

I have examined the type specimens in the Australian Museum, and find this species closely allied to *T. atriceps*, Macl., but it is larger, wider, more convex and differently coloured. I have noted the following characters as belonging to the type specimens :—Head with frontal impressions wide, shallow; prothorax evidently narrowed to base; elytra with submarginal stria obsolete on sides, discoidal puncture placed a little before middle nearer suture than lateral margin, disc with strongly impressed punctulate striæ (a wide dark fascia across middle), apex with a well marked recurved striole. Prothorax testaceous.

TACHYS QUEENSLANDICUS, n.sp.

Elongate-oval, depressed. Head impunctate, with wide shallow frontal impressions; prothorax transverse, lightly narrowed to base; elytra lightly striate near suture, submarginal stria obsolete on sides, a setigerous puncture a little before middle on course of third stria, a second similar puncture on apical declivity just within anterior extremity of the strongly impressed recurved striole. Black, or piceous, elytra with pale markings; legs pale testaceous; antennæ testaceous, slightly infuscate towards apex. (Elytra piceous near suture and narrowly so near each lateral margin, each elytron testaceous from shoulder to apex, this testaceous part spreading inwards to the second interstice a little before the discoidal seta and more or less interrupted by an external cloudy dilatation of the sutural dark patch a little behind the middle; apical declivity testaceous between recurved striolæ, more or less infuscate along course of recurved striolæ).

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* The other species is *T. (Bembidium) victoriensis*, Blkb., unknown to me in nature.

Head shagreened, front lightly convex in middle. Prothorax broader than long (0·4 × 0·68 mm.), widest before middle, declivous to base; apex very lightly emarginate; anterior angles obtuse, not prominent; sides lightly rounded, gently narrowed posteriorly, subsinuate near base, basal angles marked, obtuse at summit; base cut obliquely forward on each side to basal angles; a strongly impressed arcuate transverse line (reaching base at each end) above peduncle. Elytra truncate-oval (1·6 × 1 mm.), widely rounded at apex, subparallel on sides; two inner striæ well marked on disc, third weaker, others faint or obsolete; a short strongly raised lateral interstice extending backwards from posterior third on each elytron. Length 2·3-2·7, breadth 0·8-1 mm.

Hab.—Q. : Townsville (Dodd, Jan. to April).

This small species would, according to the tabulation I formerly made of the Australian species of *Tachys*, come into section "*t.*" It is allied to *T. infuscatus*, Blkb., which is unknown to me in nature, but I have submitted it to the Rev. Thos. Blackburn, who writes that it is not conspecific with *T. infuscatus*, being "not unlike in colouring, but darker, very much narrower and more convex, pronotum considerably less explanate and less turned up at basal angles, striæ of elytra much stronger."

TACHYS DODDI, n.sp.

Oval, depressed. Black; prothorax with a narrow piceous margin along base; elytra 5-maculate, the maculæ pale, the anterior one of each elytron small, reniform, longitudinally placed a little behind humeral angle, not touching base or lateral margin;

2nd reniform, transverse opposite beginning of apical curve (extending from 3rd to 8th stria), an apical pale spot common to both elytra; legs pale, rather lurid; antennæ fuscous, two basal joints pale.

Head lightly convex in middle between eyes; a short ridge extending backwards from base of each antenna at a little distance from lateral margin and bearing the supraorbital setæ. Prothorax transverse (0·6 × 0·9 mm.), lightly convex, rounded on sides; basal angles sharp (not dentate), rectangular. Elytra wide, ovate, depressed; three inner striæ strongly marked on disc, subcrenulate, 1st entire, 4th hardly marked; recurved striole of apex strongly marked on each elytron; submarginal stria (8th) obsolete on middle of sides, well marked behind shoulders and towards apex; two setigerous punctures on each elytron, anterior about middle on course of 3rd stria, posterior just within anterior extremity of recurved apical striole. Length 2·7-3, breadth 1·15-1·3 mm.

Hab.—Q.: Townsville (Dodd; Coll. Sloane).

According to the tabular arrangement of the Australian species of *Tachys* formerly given by me, this species goes with *T lindi*, Blkb., in Section "*uu.*" It differs greatly from *T. lindi* by colour (prothorax black, elytra black, with the posthumeral maculæ smaller and not reaching the base), striæ more strongly impressed, &c. I have dedicated it to Mr. F. P. Dodd, of Townsville, who sent me a fine series of specimens.

TACHYS *SINUATICOLLIS*, n.sp.

Oval, head with frontal impressions shallow; prothorax transverse-cordate (base wide), sides sinuate before basal angles; elytra oval, lightly convex, disc faintly striate, submarginal stria obsolete on sides, recurved striole of apex short, feebly impressed. Testaceous.

Prothorax with sides strongly rounded on anterior three-fourths, sinuate posteriorly and meeting base at right angles; basal angles rectangular (obtuse at apex); middle of base lightly produced backwards; a depressed basal area above peduncle, this area defined by an arcuate impunctate line. Elytra with sides lightly but decidedly narrowed to humeral angles, these marked (not dentate); 1st stria lightly marked, entire; 2nd and 3rd hardly perceptible; interstices flat, 3rd bipunctate along course of 3rd stria, anterior puncture about basal third, posterior at beginning of apical declivity just above the short apical recurved striole. Length 1·8-2·1, breadth 0·85-0·95 mm.

Hab.—Q.: Townsville (Dodd; Coll. Sloane).

This small species is characterised by the sides of the prothorax strongly sinuate towards base, which differentiates it from *T. uniformis*, Blkb., *T. similis*, Blkb., and *T. infuscatus*, Blkb. In the shape of the prothorax it resembles *T. transversicollis*, Macl., but differs by smaller size, elytra with the discoidal setigerous puncture nearer the suture, recurved striole of apex much shorter and more feebly impressed, sides more strongly rounded to shoulders, humeral angles well marked, not rounded, &c.

It would come into Section "*tt*" in the table of species I have given in these Proceedings (1896, p. 359), and may be tabulated thus:—

Prothorax with sides not sinuate before base............. { *T. lindi*, Blkb. / *T. doddi*, Sl.
Prothorax with sides sinuate before base.
  Elytra wholly testaceous, striæ excepting first obsolescent .... *T. sinuaticollis*, Sl.
  Elytra bicolorous, strongly impressed punctulate striæ on disc. .... { *T. atriceps*, Macl. / *T. sexstriatus*, Macl.

I have now to describe two small Subulipalpi in my collection, both of which I refer provisionally to the genus *Tachys*, though neither seems in its place in that genus. These two species (*T. obliquiceps* and *T. setiger*) show no close affinity to one another; in fact I believe each to represent a distinct genus, but I know too little of the recent classification of the Subulipalpi to place them in their proper position in the tribe, or to feel justified in suggesting new genera for them. Both have the eyes distant from the buccal fissure beneath (a trechideous character), but both seem true Subulipalpi leading towards the *Perileptides*.

TACHYS OBLIQUICEPS, n.sp.

Elongate, depressed. Head large, obliquely narrowed but not constricted behind eyes (derm microscopically shagreened and sparsely punctulate); prothorax small, subcordate, depressed; elytra with four inner striæ marked, 5th strongly impressed near shoulders, submarginal stria (8th) obsolete on sides; anterior tibiæ oblique above apex on external side. Testaceous, nitid.

Head large; front strongly biimpressed, the impressions deep, wide, parallel, extending forward to anterior margin and backwards to about opposite base of eyes; clypeus truncate; eyes lightly convex, not prominent, coarsely faceted, distant from mouth beneath. Mandibles long, prominent. Antennæ rather long; basal joint with a few long setæ, 2nd and 3rd sparsely setose, 4th-11th pubescent (moniliform). Maxillary palpi with penultimate joint thick, pyriform, pubescent, apical joint a mere projecting spike; labial palpi small, apical joint a short projecting spike, very slender but longer than that of maxillary. Ligula bisetigerous. Prothorax hardly wider than head, broader than long, broadest about anterior fourth (at anterior marginal seta), lightly narrower to base, depressed; sides lightly rounded anteriorly, lightly sinuate posteriorly and meeting the base at right angles; posterior angles sharply rectangular; base truncate on each side, produced roundly backwards above peduncle; a transverse impression on each side of base extending inwards from basal angles almost to median line; this strongly impressed, attaining base. Elytra wider than prothorax, parallel on sides; base emarginate behind peduncle, shoulders prominent but without any projection at junction of lateral and basal borders; disc lightly striate; four inner striæ lightly marked, 5th strongly impressed near base and joining lateral channel; interstices flat, microscopically punctate (the punctures not setigerous); each elytron with three discoidal punctures—two on course of 3rd stria (anterior about basal fifth, the other about middle of elytra), posterior puncture on 2nd stria at beginning of apical declivity; two short rather strongly impressed strioles on apical declivity (at about positions of 5th and 7th striæ); a few punctures along lateral margin. Length 2, breadth 0·65 mm.

Hab.—Q.: Townsville (Dodd)—N.S.W.: Tamworth (Lea; Coll. Sloane).

This species seems to lead towards *Perileptus*, the head being somewhat similar (the mandibles long and porrect), but with very different frontal impressions. It may have some affinity to the Chilian genus *Thassalobius*, which is unknown to me in nature; but the head, though decidedly narrowed behind the eyes, has the base wide and not forming a neck. Among Australian species it can only be compared with *Tachys murrumbidgensis*, Sl., and *T. leai*, Sl.; but it differs conspicuously from these species by head larger; eyes smaller, distant from buccal fissure beneath; mandibles longer and more prominent, colour, &c. *T. obliquiceps* has the margin of the elytra hardly, if at all, interrupted posteriorly by an internal plica, though this feature is tolerably well developed.

TACHYS SETIGER, n.sp.

Oblong, depressed. Pale testaceous. Derm of head, prothorax and elytra setigerous.

Head convex, wide behind eyes; surface shagreened, setigero-punctulate; frontal impressions shallow, short; eyes small, round, coarsely faceted, distant from buccal fissure beneath. Maxillary palpi large; penultimate joint large, pyriform, pubescent, apical joint very small and slender (merely a little spike); labial palpi small, apical joint a short projecting spike. Mandibles short. Prothorax depressed, lightly transverse, widest before middle, narrowed to base; derm shagreened and sparsely setigero-punctate; sides rounded on anterior part, strongly narrowed to apex, lightly and obliquely narrowed to base; anterior angles obtuse, very near head; posterior angles marked, rather obtuse; base widely sublobate, cut obliquely on each side behind posterior angles; basal area hardly defined, not below plane of disc in middle, lateral border narrow, lateral basal impressions obsolescent. Elytra depressed, rather closely setigero-punctate over whole surface, the setæ arranged in single rows along the middle of each interstice; disc striate, lateral parts hardly striate; four inner striæ clearly but lightly impressed, fainter towards base than towards apex, 1st and 3rd confluent at apex; submarginal stria (8th) wanting; a few large punctures near margins; interstices depressed, 2nd and 3rd wide towards apex, 3rd with two setigerous punctures near 3rd stria on posterior third. Length 2, breadth 0·7 mm.

Hab.—Q. : Townsville (Dodd; Coll. Sloane).

A strange and isolated species, apparently somewhat allied to *Illaphanus*, but differing conspicuously by the presence of eyes. I refer it to *Tachys* provisionally, but it is so distinct from all the other Australian species known to me that comparison with any seems useless. At a casual glance the elytra seem punctate-striate; this is caused by the presence of the rows of setigerous punctures; the striæ are not punctate.*

Tribe POGONINI.

Group **Perileptides.**

Genus PYRROTACHYS.

PYRROTACHYS CONSTRICTICEPS, Sloane.

P. constrictipes, Sl., Proc. Linn. Soc. N.S.W. 1896, xxi., p. 375.

By an unfortunate error I have published the name of this species as *P. constrictipes* (a quite meaningless name) instead of *P. constricticeps* (from the sudden constriction of the head behind the eyes). I therefore suggest that the error—an obvious one—be corrected. I would now note that *P. constricticeps* has the inner lobe of the maxillæ with a few widely placed tooth-like spines.

The Rev. Thos. Blackburn has informed me that *P. constricticeps* is, from a specimen in his possession, closely allied to the European *Perileptus areolatus*, Kreutz; and that it seems to him a species of *Perileptus*, though owing to the imperfect condition of his specimen he cannot absolutely say that it belongs to that genus.

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* See also an additional species described in Postscript, p. 641.

Want of knowledge of *Perileptus* prevents settlement of this matter by me.

Pyrrotachys constricticeps, Sl., is evidently a Trechid (as *Perileptus* is also now regarded) rather than one of the Subulipalpi. It may appropriately be separated from the other Trechides by the eyes contiguous to the mouth beneath, and the Bembidium-like apical joint of the palpi. Mr. Blackburn's genus *Trechodes* (including *Bembidium bipartitum*, Macl., which I have ascertained from inspection of the type is not a Bembidiid) comes into the group *Perileptides*.

Subtribe **Melisoderides.**

I formerly considered the Melisoderides a group of the tribe Nomiini (Horn),* but this now appears to me very doubtful; besides, it is evident from Horn's treatment of his tribe that Nomiini was the wrong name to have used, and that *Coscinia*, an older genus, should have given the name to the tribe†. In any case, I do not know the exact date of *Nomius* (Castelnau, Etud. Ent.), but *Melisodera*, Westwood, (1835) cannot be of much later date. M. Tschitschérine would evidently consider the genera forming the subtribe *Melisoderides* as part of his *Drimostomini*,‡ a subtribe of *Platysmatini*; but I think the Meonides, Melisoderides and Amblytelides should be removed from the Platysmatini on account of the mandibles having a seta in the outer scrobe of the mandibles. The typical Melisoderides are in fact Morionides with the scrobe of the mandibles setigerous.

Note.—In view of the very high importance, from a classificatory point of view, attributed to the marginal setæ of the prothorax in *Mecyclothorax* and allies by Dr. Sharp, it seems advisable to offer the following information as to this character in Australian allied genera from an examination of all the species in my possession:—Prothorax with each lateral margin (1) plurisetigerous, *Laccocenus*; (2) 4-setigerous, *Celanida;* (3) bisetigerous, *Meonis*, *Melisodera*, *Moriodema*, *Moriomorpha*, *Rhæbolestus*, *Phersita*, *Tropopterus*, *Mecyclothorax*, *Amblytelus*, *Epilyx*; (4) unisetigerous, *Dystrichothorax*. In none of these genera is the seta at each basal angle wanting.

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* Proc. Linn. Soc. N.S.W. 1898, xxiii. (Pt. 3), p. 470.

† *Vide* Trans. Am. Ent. Soc. ix. 1881, pp. 129-130.

‡ Hor. Ent. Ross. xxxv. 1902, p. 508.

Table of Genera of the Australian Subtribe Melisoderides.

i. Prothorax with sides not rounded posteriorly. Elytra with eighth interstice narrowly carinate at apex.
  A. Metepisterna long.
    b. Prothorax with a short distinct narrow ridge between marginal channel and lateral basal impressions. Eyes globular, rising sharply from head at base.
      c. Prothorax with three marginal setæ anteriorly. Elytra with 7th stria entire... ....*Celanida*.
      cc. Prothorax with one marginal seta anteriorly. Elytra with 7th stria obsolete, except on apical fourth.. ....*Melisodera*.
    bb. Prothorax without any submarginal ridge near basal angles. Orbits oblique behind eyes.
      d. Antennæ moniliform. Prothorax short.
        e. Anterior tibiæ with external side feebly arcuate; intermediate not arcuate.. ...*Moriodema*.
        ee. Four anterior tibiæ arcuate..... .... *Moriomorpha*.
      dd. Antennæ slender. Prothorax rather long (3·3 × 3·7 mm.). Intermediate tibiæ only strongly arcuate..........*Rhæbolestus*, n.gen.
  AA. Metepisterna wide and short.
    f. Antennæ moniliform..................................... ...*Phersita*, n.gen.
    ff. Antennæ slender.. ....*Tropopterus*?*
ii. Prothorax with sides rounded posteriorly. Elytra with 8th interstice not carinate at apex (except in *Cyclothorax curtus*, Sl.)......*Mecyclothorax*.†

The genus *Cyclothorax* (Macleay, 1871) must be deleted from the *Carabidæ*, having been proposed previously in the Class Arachnida (Frauenfeld, 1868), and it seems to me that its place may be taken by *Mecyclothorax*, which Dr. Sharp says only differs by the "atrophied wings from the antipodean genus *Cyclothorax*." I do not look upon this character as truly generic in itself

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* As represented by *Drimostoma alpestre*, Casteln., *D. montanum*, Casteln., and *D. australe*, Casteln.

† Sharp, Fauna Hawaiiensis, iii., 1903, p. 243.

(though Dr. Sharp has so regarded it in his work on the Carabidæ of the Sandwich Islands). I suspect that at least *M. (Phorticosomus) lateralis*, Casteln., *M. (Cyclothorax) fortis*, Blkb., and *M.? (Cyclothorax) punctatus*, Sl., have the wings atrophied, though I cannot state this as an actual fact. Doubtless *Cyclothorax curtus*, Sl., and *Cyclothorax punctatus* require to be removed from *Mecyclothorax* and placed each in a separate genus.

CELANIDA MONTANA, Castelnau.

Trans. Roy. Soc. Vict. viii. 1868, p. 123.

I hardly think any useful purpose is served by keeping *Celanida* apart from *Melisodera*; but, principally because it has a name, I am not prepared to say definitely that it should be merged with *Melisodera*. *C. montana* is the only species; it may be at once distinguished from *Melisodera picipennis*, Westw., by larger size, broader form; prothorax more transverse (3 x 5 mm.), sides less rounded anteriorly and less sinuate posteriorly, apex and base of equal width (4 mm.); elytra more strongly striate, 7th stria entire. Legs similar. Length 16, breadth 6·1 mm.

Hab.—Vic.: Mountains eastward from Melbourne.

MELISODERA PICIPENNIS, Westwood.

Mag. Zool. ix. 1835, p. 132: *Morio piceus*, Casteln., Trans. Roy. Soc. Vict. viii. 1868, p. 122.

♂. Head and prothorax piceous, elytra reddish-piceous. Elliptical, parallel. Eyes globular; orbits rising abruptly from head. Prothorax subconvex, wide (2·8 x 3·8 mm.), wider at base (2·8 mm.) than at apex (2·6 mm.); anterior angles widely rounded, not advanced; sides rounded on anterior three-fourths, sinuate posteriorly and meeting base at right angles; border thick, even; a short submarginal ridge dividing lateral basal impressions from lateral channel; two marginal setigerous punctures on each side, posterior at basal angle. Elytra oval (7 x 3·8 mm.), parallel on sides, widely rounded at apex, lightly and evenly convex, punctate-striate; 7th stria obsolete on sides; 8th interstice carinate near apex. Metepisterna elongate. Four anterior tibiæ incrassate, intermediate with apex narrower than anterior and produced externally in a prominent triangular projection. Length 11·5 mm.

Hab.—Vic.: Gippsland (French), Mount Macedon (*fide* Castelnau).

I have seen the type specimen of *Morio piceus*, Casteln., in the Howitt Collection. It had the scrobe of the mandibles setigero-punctate, and on comparing it with the species I identify as *Melisodera picipennis*, Westw., I found them to be the same.

Genus MORIODEMA.

Count de Castelnau in diagnosing his genus *Moriodema* said the mentum is "without any appearance of a tooth"; this is inaccurate, for, although the inner margin of the epilobes forms a well developed ridge across the bottom of the sinus, giving it the appearance of being edentate if not carefully examined, there is a short wide prominence or *tooth* in front of this ridge. *Moriodema* is closely allied to *Melisodera*, but it is a form that will certainly receive at least subgeneric rank from those who use subgenera, so it seems better not to merge it with *Melisodera*, from which it differs, as far as I can see from the specimens before me, by mentum with sinus shallower, the basal border not advanced in the middle; maxillary palpi with penultimate joint much longer (about as long as apical); orbits obliquely narrowed behind eyes; prothorax differently shaped and without a short submarginal ridge near basal angles; anterior tibiæ arcuate on outer side.

MORIODEMA MACOYEI, Castelnau.

Trans. Roy. Soc. Vict. viii, 1868, p. 125: *M. paramattensis*, Casteln., *ibid.*, p. 125.

Reddish-brown or piceous-red. Oval, depressed. Prothorax transverse (2·2 × 3 mm.), wider at base (2·5 mm.) than at apex (2·1 mm.); elytra truncate-oval (6 × 3·8 mm.), punctate-striate; 7th stria obsolete on sides; 8th interstice carinate at apex. Length 10 mm.

Hab.—Vic.: Yarragon (Sloane)—N.S.W.: Springwood (Sloane).

I have seen the type specimen of *M. paramattensis*, Casteln., in the Howitt Collection, where were also named specimens of *M. macoyei*, Casteln. Comparison of these with specimens in my collection from Gippsland and Springwood (Sydney District) convinces me of their identity with one another.

Genus MORIOMORPHA.

MORIOMORPHA ADELAIDÆ, Casteln.

Trans. Roy. Soc. Vict. viii. 1868, p. 124.

Two specimens (♂) of a species of *Moriomorpha* which I regard as *M. adelaidæ*, Casteln., are before me [one from Mulwala on the Murray River, found in a hollow limb of a recently fallen tree* (*Eucalyptus melliodora*); the other from near Urana, N.S.W., taken under loose bark on the trunk of a gum tree (*Eucalyptus rostrata*)].

The following brief diagnosis is founded on the specimen from Urana (the specimen from Mulwala has the prothorax more roundly ampliate at widest part and therefore of more cordiform shape). ♂. Head 1·75 mm. across eyes; orbits obliquely narrowed behind eyes (much less developed than in *Moriodema*); antennæ with 4th joint about equal in length to 3rd (in *Moriodema* the 4th joint is shorter than 3rd). Prothorax cordate (1·7 × 2·3 mm.); base and apex of equal width (1·75 mm.). Elytra strongly striate (much more strongly than in *Moriodema*); humeral angles lightly dentate, not marked. Ventral segments impressed on each side. Anterior femora thick, with a small subtuberculiform prominence on lower side near base; intermediate tibiæ strongly curved (as are also the anterior tibiæ). Length 7·8 mm.

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* *Hyperion schroetteri*, Schreib., is taken at Mulwala, though rarely, in the hollows of trees which are filled with damp dirt, in which are found numerous larvæ of large Melolonthid beetles (Passalus, &c.), on which the larvæ of *Hyperion* probably feed. It may be noted that in dry localities like Mulwala such insects as *H. schroetteri* may be only able to maintain themselves in the hollows of decaying trees because that is the only position where a sufficiency of food for their development can be found, the heat and dryness of the summer preventing the accumulation of large numbers of Passalid larvæ under logs lying on the ground, as happens in the moister forests nearer the seaboard.

Hab.—S.A.: Adelaide (*fide* Castelnau)—N.S.W.: Mulwala and Urana (Sloane), Armidale (Lea).

RHÆBOLESTES,* n. gen.

Mentum transverse; sinus deep (about one-half length of mentum), lightly oblique on sides, bordered, a short wide median prominence with widely rounded apex; lobes wide, rounded on external side, pointed at apex (the point formed by a short triangular projection of epilobes). *Palpi*: *labial* elongate; penultimate joint narrow, lightly incrassate, bisetigerous in front (apical seta very near apex); apical joint about as long as penultimate, narrow, lightly incrassate, obtusely truncate at apex: *maxillary* with second joint large, thick; two apical joints narrow, equal, hardly as long as apical joint of labial. *Maxillæ* with inner lobe narrow, strongly hooked at apex, not ciliate on inner side but armed with two widely placed slender spiniform teeth rising from prominences of inner margin, a long slender bristle before and after the anterior of these teeth: outer lobe as long as inner. *Labium* corneous, wide at apex, two long widely placed setæ at apex; paraglossæ narrow, free and extending at apex beyond ligula. *Labrum* short, transverse; apex widely and lightly emarginate, and sexsetose. *Clypeus* truncate, a setigerous pore on each side. *Mandibles* stout, hooked; a short tooth on inner side near base; a setigerous puncture in scrobe of outer side. *Antennæ* slender, long; joints 5-11 lightly compressed, pubescent; three basal joints cylindrical, glabrous—1st stout, not long; 2nd slender, short (about one-half length of 1st); 3rd slender, about equal in length to 1st; 4th about as thick as 5th, pubescent, (but narrow, cylindrical and glabrous at base). *Head* small, lightly and obliquely narrowed behind eyes; front biimpressed; two supraorbital setigerous punctures on each side, eyes prominent. *Prothorax* depressed, lightly transverse; apex and base of equal width (2·8 mm.); sides lightly sinuate posteriorly and meeting base at right angles, bisetigerous—the posterior seta a little before basal angle. *Elytra* depressed, strongly striate; base bordered; lateral border interrupted near apex and with an internal plica; 1st interstice with an elongate striole at base, 3rd 3-punctate along course of 3rd stria, 8th finely carinate on apical curve. *Mesosternum* with intercoxal declivity wide; epimera not reaching coxæ: metepisterna long. *Legs* (♂) light: anterior femora long, rather narrow; a short cylindrical hamiform process (a hook with apex sharply bent towards base of femur) projecting from lower side at about ⅓ of its length: anterior tibiæ long, narrow on basal half, wide at apex, not curved; intermediate long (longer than femora), strongly curved inwards; posterior long, slender: anterior tarsi stout, joints not dilatate, 5th longest, longer than three preceding together, basal joint much longer than 2nd, squamulose in middle of lower side near apex, 2nd and 3rd joints with two narrow rows of squamæ in middle of lower side; four posterior tarsi narrow, cylindrical, posterior much longer than intermediate; posterior coxæ contiguous.

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* ῥαιβος, bandy-legged; ληστης, a ravager.

RHÆBOLESTES WALKERI, n.sp.

♂. Elliptical, depressed, nitid. Prothorax small, lightly transverse; elytra oval. Piceous-reddish-brown; legs and body redder than upper surface.

Head (with mandibles) elongate, not large (3·1 mm. across eyes); eyes reniform, sloping roundly and strongly to head in front, more gently and obliquely behind; postocular part of orbits small, sloping backward obliquely from eyes (the slope continuous with that of eyes), front bordered on each side by a distinct ridge between eye and base of antenna; frontal impressions lightly outturned and rather wide posteriorly, ending opposite middle of eyes; spaces between frontal impressions and lateral ridges wide and rather convex. Prothorax subcordate (3·3 × 3·7 mm.), widest at anterior 3rd (at anterior marginal seta); disc subconvex, lightly declivous to sides and anterior angles, gently declivous posteriorly to a wide transverse basal depression; sides lightly rounded on anterior ⅘, sinuate posteriorly; apex widely emarginate; anterior angles obtuse, a little advanced; base truncate; basal angles subrectangular (summit obtuse); lateral border reflexed—widely so (and bearing the posterior marginal seta) near base; marginal channel wide; median line finely impressed, not extending on to the flattened basal part; lateral basal impressions wide, concave, reaching base, bordered externally by the upturned lateral border of prothorax. Elytra oval (9·3 × 5·5 mm.), depressed, strongly declivous to sides after 6th interstice; base truncate, with shoulders rounded; apex lightly sinuate on each side; sides lightly rounded; basal border slightly prominent externally (opposite base of 6th stria); lateral border reflexed, passing round humeral angle to meet basal border; striæ 3-6 slightly inturned near base, 7th obsolete except on apical third. Length 16, breadth 5·5 mm.

Hab.—N.S.W.: Ourimbah (a single specimen in my collection, given to me by Mr. J. J. Walker, R.N.).

PHERSITA, n.g.

Teraphis, Castelnau, *l.c.*, p. 127.

The genus *Teraphis* cannot stand, being too near *Teraphus*, Motschulsky (1864); therefore it is now proposed to replace it by *Phersita*.*

PHERSITA MELBOURNENSIS, Castelnau.

Teraphis melbournensis, Casteln., *l.c.*, p. 128.

I identify as *Teraphis melbournensis*, Casteln., a species sent to me by Mr. C. French. Owing to the total insufficiency of Castelnau's descriptions of his three species, it is necessary to offer a short description, so that the species I have now before me may be recognisable.

Piceous-black; inflexed margins of elytra, femora, antennæ and palpi piceous-red. Robust, elliptical. Head rather large (1·7 mm. across eyes); eyes convex; postocular part of orbits sharply raised from head; front strongly biimpressed; median space convex; lateral spaces wide and convex, bearing posteriorly (opposite middle of eyes) the large anterior setigerous supraorbital puncture; antennæ moniliform, three basal joints glabrous. Prothorax lightly transverse (1·75 × 2·25 mm.), wider across base (1·8 mm.) than apex (1·4 mm.); anterior angles wide, rounded, bordered; sides lightly rounded on anterior four-fifths, lightly sinuate posteriorly, and meeting base at right angles; basal angles sharply rectangular; two setigerous punctures on each side, posterior at basal angle; a wide basal impression on each side, reaching base externally, bordered by a short longitudinal submarginal ridge. Elytra convex, truncate-oval (4·2 × 2 8 mm.); basal border dentate at humeral angles; lateral border reflexed; striæ punctate, 1-6 deep, seventh lightly but distinctly marked; interstices 1-6 lightly convex, seventh and eighth not separately convex, eighth carinate towards apex, third bipunctate near course of third stria; anterior puncture about middle of length, posterior at beginning of apical declivity. Metepisterna (with epimera) wide, a little longer than broad. Length 6·8, breadth 2·8 mm.

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* Formed by a transposition of the letters in *Teraphis*.

Hab —Vic.: Mountains eastward from Melbourne.

Tribe **PLATYSMATINI.**

Though not now dealing generally with the Australian Platysmatini, there are some points of interest that require notice, so I take the present opportunity of placing them on record.

(1) A Note on Generic Nomenclature.

Teropha (Castelnau, 1867) should be used instead of *Morphnos* (Schaufuss, 1867), which is too near *Morphnus* (Cuvier, 1817, Aves).

Pachymelas (Tschitschérine, 1902) must supplant *Nurus* (Motschulsky, 1865), which is too near *Nura* (Heyd., 1826, Arachnida). I feel considerable doubt about the species referred to *Pachymelas* being truly congeneric with those referred to *Nurus* by M. Tschitschérine.

Castelneaudia (Tschitschérine, 1891) will have to take the place of *Homalosoma* and *Trichosternus*. *Homalosoma* (gen. ined.,

W. S. Macleay, first characterised by Brullé in 1834) was anticipated by *Homalosoma* (Wagler, 1830, Reptilia). *Trichosternus* (Chaudoir, 1865) is too near *Trichosternum* (Wollaston, 1865, Coleoptera).

Secatophus (Castelnau, 1867) must replace *Prionophorus* (Chaudoir, 1865), too near *Prionophora* (1833, 1848, 1851, and 1879), and preoccupied by *Prionophorus* (1854).

Pseudoceneus (Tschitschérine, 1891) should be used instead of *Leptopodus* (Chaudoir, 1874, ined.), preoccupied by *Leptopodus* (Cuvier, 1817, Pisces).

Cratogaster (Blanchard, 1853) antedates *Tibarisus* (Castelnau, 1867); and must replace *Cyphosoma* (Hope, 1842), which is preoccupied by *Cyphosoma* (Mann., 1837, Coleoptera).

(2) It also appears to me that the following generic, or subgeneric, names at present in use in the Australian *Platysmatini* cannot stand, and the propriety of their being changed is now suggested :—

Cyrtoderus (Hope, 1842) nom. praeoc.

Rhabdotus (Chaudoir, 1865) too near *Rhabdota* (Dejean, 1833, Coleoptera).

Ceneus (Chaudoir, 1865, gen. ined., diagnosed 1874) too near *Cenea* (Alder, 1847, Mollusca).

Nelidus (Chaudoir, 1878) too near *Nelidia* (Stal, 1861, Hymenoptera).

Eurystomis (Chaudoir, 1878) too near *Eurystoma* and *Eurystomus* previously used.

(3) New genera and species described by M. Tschitschérine as Australian :—

Liopasa crepera (gen. et sp. nov.), Hor. Soc. Ent. Ross., xxxv., 1901, p. 8.

Paranurus petri (gen. et sp. nov.), *l.c.*, p. 11; congeneric with *Trichosternus dilaticeps*, Chaud.

Castelneaudia (Trichosternus) hecate, sp. nov., *l.c.*, p. 13.

Darodilia longula, sp. nov., *l.c.*, xxxv., 1902, p. 509.

(4) Synonymy of Australian species recorded by Tschitschérine, *l c.*, 1902 :—

Castelneaudia (Homalosoma) atlas, Casteln. = *Homalosoma crassiforme*, Sloane.

Castelneaudia (Homalosoma) vigorsi, Gory = *Homalosoma alternans*, Sloane. I believe this to be correct.

Cratogaster sulcatum, Blanch. = *C. latum*, Chaud.

I record here that, from the type in the Australian Museum, *Tibarisus ater*, Macl , = *Cratogaster (Tibarisus) melas*, Casteln. M. Tschitschérine suggested this synonymyas probable (*l.c.*, p. 512). *Tibarisus niger*, Macl., is a species of *Ceneus*, apparently *C. chalybeipennis*, Chaud., from examination of Macleay's types in the Australian Museum.

PARANURUS DILATICEPS, Chaudoir.

Trichosternus dilaticeps, Chaud., Bull. Mosc. 1865, ii. p. 76.

P. macleayi, Sl., is said by M. Tschitschérine to be closely allied to *P. dilaticeps*, Chaud., and but vaguely differentiated from that species. I should say, after consideration of M. Tschitschérine's note on the species he identified as ***P. dilaticeps***,* that the species he had before him was ***P. macleayi***, but I cannot think that it is synonymous with *P. dilaticeps*. I would draw attention to the following excerpts from Chaudoir's description of *P. dilaticeps* :—

(1) "*Genis abrupte inflatis*"; (2) "*oculos convexos*" ; (3) [prothorax] "*foveolaque utrinque juxta basin breviter impressis*"; (3*a*) "*margine cum sulco basali transverso confluente*"; (3*b*) "*angulis posticis sat reflexis*"; (4) "*elytra thorace tertia parte latiora.*"

All these characters, particularly the elytra one-third wider than prothorax, do not suit *P. macleayi*, but are not inapplicable to the species I take to be *P. dilaticeps*, which, in comparison with *P. macleayi*, offers the following differences :—Form broader and less convex; head (7·8 mm. across eyes) with eyes and postocular prominences much more prominent (in *P. dilaticeps* I would call these features *prominent*, in *P. macleayi depressed*); prothorax (5·9 × 9·6 mm.) with lateral basal impressions concave, and extending laterally to the margin of the prothorax; elytra (16·5 × 11·4 mm.) less convex; third, fifth and seventh interstices less raised, particularly on apical half; seventh less raised in all its length, carinate only near base, hardly carinate near apex (in *P. macleayi* the seventh interstice is carinate in all its length, strongly so on apical curve). Length 30, breadth 11·4 mm.

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* Hor. Ent. Soc. Ross., xxxv., 1902, p. 514.

Hab.—North Queensland.

Genus CASTELNEAUDIA.

Tschitschérine, Hor. Soc. Ent. Ross., xxv., 1891, p. 166.
Homalosoma, Boisduval and other authors (*nom. praoc.*).
Trichosternus, Chaudoir and other authors (*nom. praoc.*).
Nurus, Motschulsky and other authors (in part).
Omocycla, Tschitschérine (subgen. 1902).

As noted above, the names *Homalosoma* and *Trichosternus* cannot be maintained when the laws of nomenclature are strictly enforced. *Nurus* is in a similar position, *Nura* being already in use when it was proposed. It, therefore, becomes necessary to use the name *Castelneaudia* (type *Homalosoma nitidicolle*, Casteln.). M. Tschitschérine* considers *Nurus* a genus absolutely self-contained, and divides it into two subgenera, viz., *Nurus* (type *N. brevis*, Motsch.) and *Pachymelas* (new, type *N. curtus*, Chaud.). I had formerly merged *Nurus* with *Castelneaudia*, and still see no good reasons for removing *Nurus brevis* and allies from that position; but *Pachymelas*, I think, might with advantage be constituted a distinct genus. *Omocycla* is a division which to me does not appear to require a separate name.

I take this opportunity of saying that I now concur with M. Tschitschérine in his view that it is quite inadmissible to merge *Loxodactylus* with *Castelneaudia*, as I had formerly done.

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* Hor. Soc. Ent. Ross., xxxv., 1902, p. 516.

With regard to the vesture of the underside of the tarsi in *Castelneaudia* and allied genera, it may be noted that it is usual in *Castelneaudia* for the male to have the three basal joints of the anterior tarsi dilatate and squamulose beneath (*e.g.*, *C. vigorsi*, *C. cyanea*, *C. cordata*, *C. atroviridis*, *C. obscuripennis*, &c.). *Homalosoma atlas*, Casteln., has only two basal joints slightly dilatate, and biseriately squamulose in middle of lower side; *Homalosoma imperiale*,* Sl., has (from ♂ in my Coll.) the anterior tarsi neither dilatate nor squamulose beneath. *Pachymelas curtus*,* Chaud. (from ♂ in my Coll.), *Paranurus macleayi*, Sl., and *Nuridius fortis*, Sl., have the anterior tarsi neither dilatate nor squamulose. These variations suggest that too much reliance cannot be placed on the form of the anterior tarsi in the ♂ among the large *Platysmatini*; and they help to confirm the opinion, long held by me, that any classification founded on such secondary sexual features must prove too unsatisfactory for practical use.

CASTELNEAUDIA OBESA, Castelnau.

Feronia (Homalosoma) obesa, Casteln., Trans. Roy. Soc. Vict. viii. 1868, p. 204.

I have recently seen a specimen of *C. (Homalosoma) obesa*, Casteln., in the Howitt Coll., where were also specimens of *C. (Homalosoma) atlas*, Casteln. No specimens of *C. brevis*, Motsch., or *C. latipennis*, Sl., were available for comparison with *C. obesa*, and my time was too limited to make a detailed description of it, so that I have merely the following brief note on it. *C. obesa* (♀) of similar facies to *C. atlas*, but smaller, prothorax with anterior angles sharply advanced; *C. atlas* (♀) with anterior angles of prothorax obtuse and not advanced.

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* The discovery, that in the ♂ of these two species the anterior tarsi are naked beneath, gives a partially negative answer to M. Tschitschérine's statement concerning the anterior tarsi in the five species he attributes to the genus *Nurus* (Hor. Soc. Ent. Ross., xxxv., 1902, p. 516).

CASTELNEAUDIA LATIPENNIS, n.sp.

♀. Robust; head large; prothorax transverse, subcordate, base narrower (6 mm.) than apex (7·1 mm.), sides lightly sinuate posteriorly and meeting base at right angles, anterior angles advanced; elytra short, oval, rounded on sides, widest behind middle, humeral angles dentate, third interstice 3- or 4-punctate. Intercoxal declivity of prosternum setigero-punctate, of mesosternum glabrous. Posterior coxæ contiguous. Head and undersurface black; prothorax nitid, black on disc, cupreous or brassy-green towards sides; elytra finely shagreened, black or of a dull bronzy tint, summits of costæ subnitid, marginal channel and ninth interstice cupreous.

Head large (6·7 mm. across eyes), smooth, swollen on each side behind and below eyes. Prothorax depressed, transverse (5·5 × 8·3 mm.—lateral length 6·5 mm.), widest just behind anterior marginal puncture; sides lightly rounded on anterior half, lightly narrowed posteriorly, lightly sinuate about 1·5 mm. before base; apex emarginate; anterior angles rather strongly advanced, obtusely rounded; base emarginate in middle, basal angles well marked, rectangular, with apex obtuse; lateral margin rather wide; border thick, lightly reflexed except near apical angles; lateral basal impressions short, connected by a well marked transverse impression. Elytra oval (15 × 11 mm.), rounded on sides, widely rounded at apex, a little narrowed to base; interstices wide, lightly costate, seventh stronger than others, subcarinate near base, ninth nitid, hardly distinct from margin, a little raised posteriorly. Ventral segments lævigate; fourth and fifth with a few setigerous punctures in middle near posterior margin; apical 4-setigerous on posterior margin, and with two or three fine setigerous punctures in middle a little before apex. Length 29, breadth 11 mm.

Hab.—N.S.W.: Dunoon, Richmond River (R. Helms).

This is the species I have referred to as *C. (Nurus) brevis*, Motsch., in my description of *C. (Homalosoma) imperialis;* but I now consider *C. brevis* to be identical with *Homalosoma solandersi*

Casteln. (following in this MM. Chaudoir and Tschitschérine). A specimen of *Homalosoma solandersi*, Casteln., agreeing with specimens so named in the Macleay Coll., is before me; it differs from *C. latipennis* by colour (margins of elytra and prothorax bright green); prothorax with sides not sinuate before base, basal angles far more obtuse and less marked; elytra more convex, interstices less raised to the summits (widely and roundly convex), seventh much less carinate, especially near base. Dimensions: Length 27; proth. 5·5 × 8·5, apex 6·7, base 6·5; el. 13·2 × 10 mm.

I believe *C. latipennis* differs sufficiently from *C. brevis* to be regarded as a distinct species.

CASTELNEAUDIA SUBVIRENS, Chaudoir.

Homalosoma subvirens, Chaud., Bull. Mosc. 1865, ii., p. 72.

C. subvirens has remained unknown since Chaudoir described it till now. I have identified it in a species from South Queensland (Tambourine Mountain) received from Mr. C. French. It seems sufficiently well described to be recognisable; but to show its position in the genus, and to enable the species to which I have applied the name *C. subvirens* to be recognised, the following brief descriptive note is offered. According to the tabular list of species I already have given in these Proceedings (1899, p. 567), its position would be in section "C."

Allied to *C. angulosa*, Chaud., but differing by upper surface more convex; prothorax not so flat, sides more strongly rounded, lightly sinuate before base; elytra virescent (not black), more convex, space between seventh costa and marginal channel more strongly declivous, seventh interstice less carinate except near base, 8th interstice not separated from ninth near apex. Dimensions: Length 26; head 5·25 across eyes; proth. 5·4 × 7·3, apex 5·3, base 6; el. 14 × 8·6 mm.

The intercoxal declivities of prosternum and mesosternum are setigero-punctate. A specimen (♂) before me has the anterior tarsi neither dilatate nor squamulose beneath*; abdomen with a single puncture on each side of apex; elytra with third interstice impunctate. A second specimen (♀) has the third elytral interstice unipunctate at beginning of apical declivity. (Chaudoir described the elytra as with third interstice bipunctate).

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* This character is very remarkable in a species of section "C," so much so that one wonders whether it may not be merely an individual peculiarity in the specimen I have.

CASTELNEAUDIA PORPHYRIACA, Sloane.

Homalosoma porphyriacum, Sl., Proc. Linn. Soc. N.S. Wales, 1899, p. 571.

M. Tschitschérine has pointed out that I have not referred to the supraorbital punctures of the head, and the marginal punctures of the prothorax when describing this species. This omission has had the unfortunate effect of causing him to assign a wrong position to it in his table of species. I take the present opportunity of noting that these features are normal, viz., two supraorbital punctures on each side of head, and two setigerous prothoracic marginal punctures. It would come into section "22" of M. Tschitschérine's table, having all the characters necessary to bring it into that position; it could then be separated from *C. wilsoni*, Casteln., thus:—

Prothorax with basal angles obtuse................................ *C. porphyriaca.*
Prothorax with basal angles rectangular........ ....*C. wilsoni.*

Genus NOTONOMUS.

Since my "Revision of the Genus Notonomus,"* certain information in regard to the species has been obtained to which attention should be directed:—

(1) M. Tschitschérine has brought under my notice that, while in *Notonomus* it is usual for the fifth joint of the tarsi (*onychium*) to be glabrous beneath, yet in some species this joint is spinulose beneath. This seems a useful observation of a good aid to the identification of some species. I therefore record here the following as all the species known to me with the onychium (*a*) spinulose beneath, viz., *N. kosciuskianus, rainbowi, satrapa, colossus, eques,*

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* These Proceedings, 1902, xxvii.

spenceri; (*b*) with a single spinule beneath on each side, *N. froggatti* and *N. æneomicans.*

(2) M. Tschitschérine has also informed me that he places a high value on the upper side of the tarsal joints being longitudinally striolate, as in *N. eques*, Casteln. I made no use of this feature, but now record that, among the described species known to me, it is only present in *N. strzeleckianus*, *phillipsi* (of Sloane's Revision), *froggatti*, *eques* and *spenceri*; also *atripennis*, n.sp.

(3) I have also heard from M. Tschitschérine that he has reason to think, though not speaking positively in any case, that :—

(*a*) *N. crœsus*, Casteln., and *N. plutus*, Casteln., are two distinct species.

(*b*) *N. kingi*, Chaud.,=*N. excisipennis*, Sl. This would leave the species I have identified as *N. kingi*, Chaud., without a name.

(*c*) *N. parallelomorpha*, Chaud , is probably synonymous with *N. auricollis*, Casteln., while *N. opulentus*, Casteln., is quite a distinct species.

The further investigation of these points by M. Tschitschérine will be awaited with interest.

NOTONOMUS ATRODERMIS, n.sp.

N. rufipalpis, Sl., Proc. Linn. Soc. N.S.W. 1902, xxvii. p. 315 (not *Omaseus rufipalpis*, Casteln.).

The species I regarded as *Omaseus rufipalpis* was wrongly identified, and requires a new name.*

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* The Rev. Thos. Blackburn has given me a specimen (taken by him in the Victorian mountains) which he has identified as *Omaseus rufipalpis*, Casteln. I concur with this identification, and would refer it to *Simodontus*, but it differs from the typical species of that genus and leads towards *Prosopogmus; it seems allied to S. grandiceps*, Sl. It is characterised by head large (3·25 mm. across eyes); prothorax wide (3·25 × 4·6 mm.), posterior marginal puncture distant from basal angle; elytra widely rounded at apex without lateral apical sinuosities, third interstice bearing more than three punctures; metasternal episterna quadrate; intercoxal declivity of prosternum rounded, but broad in middle. Length 14·5, breadth 5·75 mm.

NOTONOMUS SATRAPA, Castelnau.

Elongate oval, subparallel, strongly convex. Black, legs piceous-red. Head large (5 mm. across eyes), convex; eyes convex, deeply enclosed in swollen orbits on posterior and lower sides. Prothorax cordate (5·2 × 6·3 mm.), wider across apex (5 mm.) than base (4·3 mm.), lightly rounded on sides; basal angles obtuse; basal impressions wide; posterior marginal puncture distant from basal angle (0·6 mm.) on inner side of marginal channel. Elytra oval (13·2 × 7·6 mm.), convex, subdepressed near suture, strongly declivous to sides and apex; humeral angles not marked; basal border joining lateral border without interruption at humeral angles; striæ strongly impressed; interstices lightly and evenly convex, third 5-punctate, fifth impunctate, seventh 4-punctate. Intercoxal declivity of prosternum narrow and rounded in middle; of mesosternum wide, concave. Tarsi with fifth joint spinulose beneath, two or three strong short spinules on each side. Length 24·5, breadth 7·6 mm.

Hab.—Vic.: Crooked River (two specimens [♀] in Howitt Coll.).

When in Melbourne recently I found in the Howitt Collection two specimens ticketed "*Feronia satrapa*, Casteln., Crooked River." A specimen (♀) has been in my possession for many years, without locality, but I passed it over when reviewing the genus *Notonomus* last year because Castelnau's description of the elytra as "rather depressed" seemed unsuited to this unusually convex species. Compared with *N. pluripunctatus*, Sl. (=*N. satrapa*, Sl., not Castelnau), the following differences are noted (unfortunately I am only able to compare the ♀ of *N. satrapa* with the ♂ of *N. pluripunctatus*):—Form more convex and parallel; prothorax less narrowed to base, posterior marginal puncture further from basal angle; elytra with fifth interstice impunctate; tarsi with onychium spinulose beneath. From *N. gippsiensis*, Casteln. (of which Chaud. suggested it was merely a variety), *N. satrapa* is distinct by its narrower and more convex form; larger head; narrower and less depressed prothorax with posterior marginal puncture not at basal angle; elytra narrow, more convex, interstices more convex, seventh punctate, third incrassate on apical declivity; onychium spinulose beneath.

N. satrapa and *N. pluripunctatus* are closely allied, and may be tabulated thus:—

Black; tarsi with onychium spinulose beneath..............*N. satrapa.*
Upper surface with a bronzy or greenish hue; tarsi with
onychium glabrous beneath.................... ....*N. pluripunctatus.*

NOTONOMUS PLURIPUNCTATUS, n.sp.

N. satrapa (var.?), Sloane (not Castelnau), Proc. Linn. Soc. N.S. Wales, 1902, xxvii. (Pt. 2) p. 270.

This species, which I formerly described as a variety of *N. satrapa*, Casteln., now seems quite distinct, and therefore requires a name. It is sufficiently described in my "Revision"; the differences between it and *N. satrapa* are indicated above.

NOTONOMUS TAYLORI, n.sp.

♂. Elliptical-oval, robust, convex. Head large (4 mm. across eyes), convex. Prothorax short, convex, equally rounded on sides, basal angles rounded off; elytra oval, strongly striate, humeral angles rounded off, third interstice 3- or 4-punctate, eighth wider than ninth, not convex. Black, nitid, elytra of a dark coppery colour.

Prothorax broader than long (5 × 5·7 mm.), of equal width between posterior marginal punctures and across apex (4 mm.); sides lightly rounded, equally and roundly narrowed to apex and base; apex and base truncate; posterior marginal puncture on inner side of marginal channel at place of posterior angle; lateral border narrow, even, reaching posteriorly to lateral basal impressions; marginal channel also extending to basal impressions; these short, rather wide, not deep. Elytra oval (12 × 7 mm.), convex; basal border joining lateral border at humeral angles without interruption; inner humeral angle wide; interstices roundly convex, tenth well developed on posterior third. Intercoxal declivity of prosternum rounded; of mesosternum concave.

Femora stout; tarsi piceous, fifth joint glabrous beneath. Length 21, breadth 7 mm.

Hab.—N.S.W.: Oberon (Taylor; Colls. Taylor and Sloane).

This fine species was sent to me by Mr. W. J. Taylor, of Sydney, as coming from Oberon.* Allied to *N. arthuri*, Sl., but differing by colour, larger size, more massive form; prothorax proportionately shorter, more convex, evenly rounded on sides to apex and base, basal angles more widely rounded. In general appearance it much resembles *N. variicollis*, Chaud., but differs at once and decidedly by the form of the prothorax with posterior angles quite rounded off.

NOTONOMUS BESTI, Sloane, var. ÆNEODORSIS, var.nov.

N. besti, Sl., seems a variable species; the typical form is from the mountains of the Upper Yarra. It has elytra dark coppery purple, prothorax and head metallic-purple. Length 15-19·5, breadth 5·1-6·7 mm.

Var. *æneodorsis*, var.nov.—Upper surface of a greenish-brassy colour; prothorax a little less ampliate at widest part; elytra with third interstice 5-punctate. Length 15-19·5, breadth 5·1-6·7 mm. [♂ Length 16·5; head 3 across eyes; proth. 4 × 4·5 (apex 3, base 3·3); el. 9·2 × 5 4 mm. ♀ Length 19·5; head 3·7 across eyes; proth. 4·7 × 5·6 (apex 4, base 4); el. 11·5 × 6·7 mm.].

Hab.—Vic.: Mountains of Upper Ovens River (Harrietville, Best; Porpunkah, W. Sloane).

This is the species referred to in my Revision in "Note (2)" under *N. besti*. Several specimens have been given to me by Mr. D. Best of Melbourne, taken by him near Harrietville in October; it seems a constant form, but I hesitate to consider it thoroughly distinct from *N. besti*, though it seems sufficiently different to receive a varietal name.

NOTONOMUS ATRIPENNIS, n.sp.

♂. Oval, subparallel, subdepressed. Head small; prothorax subquadrate, wider at base (4 mm.) than at apex (3·3 mm.), posterior angles obtuse, posterior marginal puncture distant from basal angle; elytra strongly striate, interstices convex, third 5- to 7-punctate, tenth well developed, narrow, not long. Black, nitid; prothorax sometimes with a faint greenish tinge on sides near lateral basal impressions; legs, antennæ and mouth-parts piceous-red.

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* Oberon, 16 miles south of Tarana, on the Western Railway Line.

Head small (3·2 mm. across eyes); front lightly and widely biimpressed; eyes enclosed in strongly developed orbits, so that the head appears somewhat constricted behind them. Prothorax broader than long (4·4 × 4·8 mm.), depressed in middle and posterior parts of disc, declivous to anterior angles; sides very lightly and evenly rounded on anterior two-thirds, obliquely and lightly narrowed to base; basal angles obtuse, but well marked; base truncate, widely subsinuate in middle, very lightly rounded on each side; posterior marginal puncture on inner side of lateral channel, a little before basal angle; border wide and strongly reflexed on posterior half, continuing round basal angles on to base on each side; median line finely but strongly impressed; lateral basal impressions of moderate length, narrow, not deep, not reaching base in full depth. Elytra truncate-oval (10·2 × 5·9 mm.), lightly convex, subparallel on sides; lateral sinuosities of apex rather strongly developed; basal border lightly raised at humeral angles to form an obtuse stout prominence, posterior margin hardly rounded; lateral border widely reflexed near base. Intercoxal declivity of prosternum rounded; of mesosternum concave. Posterior femora with lower side strongly dilatate above apex of trochanters; tarsi with upper surface (excepting basal joint) longitudinally striolate, fifth joint glabrous beneath. Length 16·5-18, breadth 5·6-6·15 mm.

Hab.—Vic.: Harrietville (Best); Mountains on upper waters of the Ovens River (Blackburn).

In general appearance resembling *N. muelleri*, Sl., but differing decidedly by elytra with lateral border widely reflexed near the humeral angles which are subdentate, interstices more convex; posterior femora strongly dilatate on lower side above trochanters, tarsi with upper surface striolate. It is allied to *N. froggatti*, Sl., with which it agrees in all the features mentioned above, but differs by elytra not margined with green, basal border far less strongly dentate at humeral angles, lateral sinuosities of apex deeper. From *N. spenceri*, Sl. (with which it also agrees in the features mentioned as distinguishing it from *N. muelleri*), it differs by want of a green elytral border; more depressed upper surface; prothorax longer, less rounded on sides and at basal angles; intercoxal declivity of prosternum not flat.

NOTONOMUS PLANIPECTUS, n.sp.

Elongate-oval, subparallel; head moderate (2·75 mm. across eyes), eyes subprominent; prothorax nitid, transversely striolate (the striolæ faint and wavy), subquadrate, sides rounded, a little narrowed to base, basal angles rectangular, posterior marginal seta on inner side of marginal channel opposite basal angle; elytra deeply striate, interstices strongly convex, third 2-punctate, sixth not narrowed near base, eighth narrow, convex; humeral angles dentate. Black.

Head convex, wide across occiput and between eyes; front strongly biimpressed, the impressions short, arcuate, sharply outturned before and behind; eyes convex, not prominent, strongly inclosed behind; postocular part of orbits about as long as eye and rising gradually from head. Prothorax broader than long (4·25 x 4·8 mm.), widest about middle, wider across base (3·75 mm.) than across apex (3·3 mm), depressed posteriorly; sides lightly rounded, not ampliate at widest part, lightly subsinuate just before base; apex emarginate, anterior angles a little prominent but obtuse, rather widely bordered; base lightly emarginate in middle, truncate on each side; border widely reflexed on basal two-thirds of sides, narrower towards apex, extending as a narrow edge on each side of base to basal impressions; median line strongly impressed, reaching base; lateral basal impressions deep, narrow, parallel. Elytra truncate-oval (10 x 5·7 mm.), rather depressed on disc, strongly declivous on sides and apex; sides very lightly rounded; lateral apical sinuosities well developed; basal border lightly curved on posterior margin, strongly raised into an obtuse projection at humeral angles; lateral border widely reflexed, a little narrower near base; striæ simple; interstices strongly convex, the discoidal ones not becoming carinate on apical declivity, 1-7 about equal in width on basal half, eighth and ninth narrow (about equal in width on basal half), inner margin of ninth interrupted by umbilicate punctures, tenth well developed before apical sinuosity (but not long). Prosternum depressed between coxæ; basal declivity flat, wide; mesosternum with intercoxal declivity flat. Femora stout, posterior with lower side dilatate above trochanters. Length 17, breadth 5·7 mm.

Hab.—Q.: Tambourine Mountain, near Brisbane (Illidge; Colls. Illidge, Lea and Sloane).

Belongs to the *N. nitidicollis*-group, which is characterised by having the intercoxal declivity of the prosternum flat, elytra with third interstice bipunctate, pronotum nitid and with posterior marginal seta not placed on border, &c. It may be distinguished at once from *N. nitidicollis*, Chaud., *N. latibasis*, Sl., *N. queenslandica*, Sl., and *N. subopacus*, Chaud., by its larger size, wholly black colour, elytra with sixth interstice not narrowed near base; from *N. violaceomarginatus*, Macl., by the same features, excepting size, and by the more elongate prothorax with rectangular basal angles. In facies it more resembles *N. lirugerus*, Sl., than any other species known to me, its head, prothorax and elytra being in a general way somewhat similar, but it differs by form stouter and less depressed; eyes less prominent; posterior marginal puncture of prothorax not placed at basal angles on a dilatation of the border; elytra more convex, with interstices 2-5 hardly narrowed and not carinate at apex.

It seems impossible for *N. planipectus* to be *N. ingratus*, Chaud., which is unknown to me, but which, from Chaudoir's notes, must be taken to have the prothorax with basal angles not rectangular; besides, I think the elytral interstices of *N. planipectus* could not be described as "*parum et æqualiter convexis*;" nor could the humeral angles, which are unusually strongly dentate, be said to be "*minime dentatis.*"

NOTONOMUS MELAS, n.sp.

Oval, robust; head rather large (2·7 mm. across eyes); prothorax nitid, subquadrate, with sides strongly and evenly rounded, posterior marginal puncture placed a little before base on inner side of lateral channel; elytra truncate-oval, deeply striate, interstices equal, third 2-punctate, sixth not perceptibly narrowed at base; eighth and ninth very narrow, convex, almost equal in width; black.

Head wide at base and between eyes, convex; front lightly biimpressed; eyes convex, rather prominent, strongly inclosed at base; postocular part of orbits two-thirds size of eyes, rising strongly from head in a curve continuous with that of eyes. Prothorax broader than long (3·5 × 4·3), widest about middle, very little wider at base (3 mm.) than apex (2·8 mm.); apex very lightly emarginate; anterior angles obtuse; base truncate, convex above peduncle; basal angles marked but obtuse; border narrow on anterior half of sides, wide towards base, extending very narrowly along base on each side almost to middle; median line almost touching base; lateral basal impressions strongly impressed, rather wide, not long. Elytra truncate-oval (7·8 × 5 mm.), lightly and evenly rounded on sides, feebly sinuate on each side of apex, convex; striæ simple, interstices 2-7 strongly convex, equal on basal half, narrower and more strongly convex at apex, ninth with inner margin interrupted by umbilical punctures, tenth narrow, elongate, convex (extending forward from apical sinuosity to middle of sides). Intercoxal declivities of prosternum and mesosternum flat. Length 14, breadth 5 mm.

Hab.—N.S.W.: Glen Innes (Lea).

Belongs to the *N. nitidicollis*-group. It is readily differentiated from *N. nitidicollis*, Chaud., *N. latibasis*, Sl., and *N. queenslandicus*, Sl., by colour wholly black; prothorax more transverse, more strongly rounded on sides, with basal angles not sharply marked;—from *N. subopacus*, Chaud., by colour; more robust form; prothorax much wider, more strongly rounded on sides, &c.;—from *N. violaceomarginatus*, Macl., by colour; smaller size;

elytra with interstices not opaque and depressed in ♀, sixth not narrowed to base, &c.;—from *N. planipectus*, Sl., (the nearest allied species known to me) by smaller size; larger head; prothorax proportionately wider, more strongly rounded on sides, basal angles not rectangular. It must be allied to *N. viridilimbatus*, Casteln., (of which I have not a specimen for comparison) but has not a green margin, and the prothorax must be, proportionately to its width, longer (it could not be taken to be "longer than the breadth"—Macleay's description of *N. cyaneocinctus*); the ♀ has not the elytra opaque with interstices "not convex" (Castelnau's description of *Feronia viridimarginata*); the third and fifth elytral interstices are not "broader than the others" (Castelnau's description of *Feronia viridilimbata*).

NOTONOMUS CUPRICOLOR, n.sp.

♂. Elongate-oval, subconvex; head rather large (3·8 mm. across eyes); prothorax subcordate, hardly wider at base (3·8 mm.) than at apex (3·7 mm.), posterior angles subrectangular, posterior marginal puncture in lateral channel a little before basal angle; elytra finely and lightly striate, interstices flat, 3rd 5-punctate, 8th narrow, 10th long, extending forward beyond middle of elytra. Intercoxal declivity of prosternum flat, of mesosternum deeply concave. Upper surface æneous, prothorax more cupreous than elytra; under surface black; legs and palpi red; mentum, mandibles, metathorax and posterior coxæ piceous-red; antennæ reddish-piceous.

Head smooth, wide and convex between eyes; front biimpressed, the impressions arcuate, well marked; mandibles not long and decussating; eyes prominent; postocular part of orbits two-thirds the size of eyes, rising sharply from head. Prothorax broader than long (4·6 × 5·4 mm.), widest before middle; sides strongly rounded at widest part, gently and obliquely narrowed to base without sinuosity; basal angles strongly marked, almost rectangular, obtuse at summit; border wide, narrower towards apex, widely reflexed towards base; lateral basal impressions long, narrow, uniting with posterior extremity of lateral channel.

Elytra oval (12 × 6·7 mm.), lightly and widely convex; apical declivity lightly declivous; sides lightly rounded, apical sinuosities strongly developed, wide; striæ finely but distinctly impressed; interstices flat, discoidal ones subconvex at apical extremity, 7th and 8th narrow and convex opposite apical sinuosities, 7th flat on basal half, wide, depressed and 3-punctate near apex, 8th about half the width of 7th on basal half, narrower than 9th (except on basal third), 9th rather evenly seriate-punctate; lateral border wide, turning in to base gently and evenly (without any marked curve); basal border not raised above lateral border at their point of junction. Legs long; femora stout, swollen in middle; posterior tibiæ long, straight; tarsi as usual in genus, fifth joint non-setulose beneath. Length 21, breadth 6·7 mm.

Hab.—Vic.: Mt. Baw Baw (Coll. French).

A distinct species, isolated from all others by the following features in combination—large size; elytra with fine but distinct striæ, eighth interstice narrow; prosternum with intercoxal declivity flat and furnished with four long setæ. In general appearance it resembles *N. crœsus*, Casteln., but differs conspicuously by all the features mentioned above, and by the mandibles being pincer-like, not long and decussating: its facies is that of *N. chalybeus*, Dej., but the more strongly striate elytra are in themselves sufficient to distinguish it.

Following the tabular list of the species of *Notonomus* previously given by me (these Proceedings, 1902, xxvii. Pt. 2, pp. 256-261), it would follow *N. spenceri*, and could be tabulated thus:—

* Elytra with striæ strongly impressed, interstices convex .... *N. atrodermis*, Sl.
N. eques, Casteln.
N. spenceri, Sl.

** Elytra with striæ lightly impressed, interstices flat...*N. cupricolor*, Sl.

Genus SARTICUS.

Sarticus is, strictly speaking, only a subgenus of the huge and universal genus *Platysma;* but, when treating of local faunas, such subgeneric groups may with advantage be conceded full rank as genera, and in this way it is now used.

When I formerly reviewed the species of *Sarticus* (These Proceedings, 1889, [2] iv.) I offered a diagnosis of the genus which may be taken as accurate for the typical species of the genus; but there are three species* which offer decided differences, and which would have to be excluded from *Sarticus* if that generic definition were rigidly adhered to. It seems better to place such aberrant species in a genus beside their nearest allies, rather than to place them in different named groups with an idea of maintaining symmetry in what may be, after all, a confused and artificial system of classification.

The following features require notice:—

(1) *Prosternum* with intercoxal declivity always rounded; anterior margin usually with an entire border, sometimes obsolescent in middle, but only wanting altogether in *S. sulcatus* and *S. blackburni*. In my descriptions of *S. aubei*, Casteln., *S. macleayi*, and *S. monarensis*, I have said, "prosternum without a margin"; this referred to the base of the intercoxal part.

(2) *Mesosternum* with intercoxal declivity usually deeply emarginate (but hardly at all so in *S. impar*).

(3) *Onychium* (= fifth joint of tarsi) spinulose or not beneath. As mentioned above (under *Notonomus*), my attention has been drawn to this feature by M. Tschitschérine. It seems constant, and I now record it among the species known to me as under:—

(*a*) Onychium spinulose beneath:

S. sulcatus, blackburni, aubei, discopunctatus, coradgeri, obesulus esmeraldipennis, civilis, habitans, macleayi, cooki, ischnus.

(*b*) Onychium glabrous beneath:

S. impar, cyaneocinctus, dampieri, monarensis, cyclodemus, iriditinctus.

(4) Third elytral interstice normally 3-punctate, but in *S. civilis*, *S. brevicornis*,† and *S. dampieri* 4-punctate.

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* *S.* (*Coronocanthus*) *sulcatus*, *S.* (*Pterostichus*) *blackburni*, Sl., and *S impar*, n.sp.

† Unknown to me in nature.

I offer the following tabular view of the species to replace my former table, which was wanting in exactness, and otherwise unsatisfactory. In such closely allied forms it is often difficult to find differentiating characters suitable for a table; therefore some of those now suggested may appear trivial, but they are believed to be constant and worthy of attention :—

Table of Species.

A. Elytral sculpture abnormal, only three deep striæ on disc of each elytron; interstice between first and second striæ very wide, nearly twice as wide as interstice on each side of it................................*S. sulcatus*, Macl.

AA. Elytra striate normally.

B. Prothorax with lateral basal impressions not forming a rounded concavity inclosed posteriorly by the lateral border.

C. Prothorax with lateral border explanate; prosternum with anterior margin not bordered; mesosternum with intercoxal declivity deeply concave; elytra with crenulate striæ, interstices equal, third unipunctate near apex .... *S. blackburni*, Sl.

CC. Prothorax with lateral border narrow; prosternum with anterior margin bordered; mesosternum with intercoxal declivity hardly at all concave; elytra simply striate; third, fifth, and seventh interstices much wider than others, third tripunctate......*S. impar*, Sl.

BB. Prothorax with a deep concavity on each side of base inclosed behind by the widely explanate lateral border.

D. Form stout; posterior tarsi with penultimate joint small, triangular.

e. Mesosternal and metasternal episterna impunctate.

f. Elytra with sixth and seventh interstices coalescing at base and forming a humeral elevation............*S. cyaneocinctus*, Chaud.

ff. Elytra without posthumeral elevation.

g. Dorsal striæ simple.................... . ... *S. aubei*, Casteln.

gg. Dorsal striæ crenulate.

h. Elytra with lateral apical sinuosities obsolete........ . ...*S. discopunctatus*, Chaud.

hh. Elytra with apical sinuosities well developed.

i. Elytra with interstices 1-7 strongly convex, particularly posteriorly..................... ....*S. coradgeri*, Sl.

ii. Elytra with interstices lightly convex, hardly or not at all convex above apical declivity.

j. Prothorax with sides roundly ampliate, border explanate before basal foveæ; elytra with seventh interstice feebly impressed............ ....*S. obesulus*, Chaud.

jj. Prothorax with sides lightly rounded, border rather narrow, not explanate before basal foveæ; seventh interstice strongly impressed............................ ....*S. esmeraldipennis*, Casteln.

ee. Mesoternal and metasternal episterna punctate.

k. Ventral segments nitid, three apical only punctate on sides near anterior margins, third impunctate, second with a few punctures.

l. ♀ with elytral interstices nitid.

m. (♀) Prothorax with border unusually widely and strongly reflexed posteriorly, wide before basal foveæ. Elytral striæ not shallower towards apex. Onychium glabrous beneath.. ....*S. dampieri*, Sl.

mm. Prothorax with border narrow in front of basal foveæ; elytral striæ shallower posteriorly. Onychium setulose beneath.. ....*S. civilis*, Germ.

kk. Ventral segments, including second and third, finely punctate near sides; elytra black. (Onychium setulose beneath.)

n. Prothorax with sides strongly rounded (strongly curved posteriorly); elytra with inner humeral angle wide...... ....*S. habitans*, Sl.

nn. Prothorax evidently narrowed to base; elytra with inner humeral angle marked..... ... .*S. macleayi*, Sl.

ll. Elytra in ♂ nitid with a metallic flush, in ♀ with interstices depressed, opaque.

o. Onychium setulose beneath. Elytra, especially in ♂, bluish..................... ....*S. cooki*, Sl.

oo. Onychium glabrous beneath. Elytra, especially in ♂, virescent.................................*S. monarensis*, Sl.

DD. Form graceful; size small (8·5-10 mm.). Posterior tarsi long, slender; penultimate joint narrow and hardly widened at apex
S. cycloderus, Chaud.
S. iriditinctus, Chaud.
S. ischnus, Casteln.

I have nothing to add in reference to *S. cycloderus*, *S. iriditinctus*, and *S. ischnus*. *S. obscurus*, Blkb., (unknown to me in nature) seems allied to *S. cycloderus*.

S. rockhamptonensis, Casteln., has been omitted from the table given above, because I have felt unable to deal with it in a satisfactory way; for a note on it, *vide* my "Review." The specimen (♀) there referred to remains unique in my collection, and is not in a good state of preservation. I may note here that the tarsi have the fifth joint glabrous beneath. My specimen has been many years in my possession, with the locality "Rockhampton District" attached to it; but I do not know the authority for this. It is in all probability *S. rockhamptonensis*, for I do not think *S. obesulus* extends to Queensland, and therefore can not follow Chaudoir in placing it under *S. obesulus*. It is very closely allied to *S. monarensis*.

SARTICUS SULCATUS, Macleay.

Coronocanthus sulcatus, Macl., Proc. Linn. Soc. N.S.W. 1878, ii. p. 216: *Feronia (Sarticus) quadrisulcatus*, Chaud., Bull. Mosc. 1878, liii. p. 67.

I am not prepared to accept Macleay's genus *Coronocanthus* as distinct from *Sarticus*, and therefore support Chaudoir's reference of the species to *Sarticus*.

Attention may be drawn to—the abnormal sculpture of the elytra; the border along the apex of pronotum obsolete in middle; prosternum not bordered along anterior margin; ventral segments not punctate; basal segment impunctate, and with a wide raised border behind metasternal epimera and posterior coxæ.

The basal ventral segment requires study in *Notonomus*, *Sarticus* and allied genera. It varies by being punctate or impunctate; the lateral border of the ventral segments sometimes curving across the segment behind the metasternal epimera, sometimes not, rarely it is the second segment which has the anterior margin bordered; these variations seem constant, and are therefore useful as a help in differentiating species.

SARTICUS BLACKBURNI, Sloane.

Pterostichus blackburni, Sl., Proc. Linn. Soc. N.S.W. 1894 (2), ix. p. 426.

This species may, at least provisionally, be referred to *Sarticus*. It has the prothorax with basal angles marked, anterior margin not bordered in middle; prosternum with apex not bordered; ventral segments lævigate, the basal segment impunctate and without a raised border behind metasternal epimeron.

SARTICUS IMPAR, n sp.

♂. Elongate-oval, convex; elytra oval, strongly, fully and simply striate, interstices 3rd, 5th and 7th wide; 2nd, 4th and 6th narrow, 3rd 3-punctate, a short striole at base of first interstice. Black; mouth-parts and tarsi piceous-red.

Head oval (2·4 mm. across eyes), convex, lævigate; supra-antennal carina short, arcuate; eyes convex, not very prominent, lightly enclosed at base. Prothorax a little broader than long (3·1 × 3·4 mm.), widest about middle, hardly wider at base (2·4 mm) than at apex (2·35 mm.); sides lightly rounded; apex truncate, basal angles obtuse but a little marked; border narrow on sides, hardly wider towards base, obsolete on middle of apex and on base between lateral basal impressions; median line lightly impressed, a punctiform fovea at its posterior extremity; lateral basal impressions wide, short; posterior marginal puncture at basal angle inside the border on a narrow raised space dividing the lateral basal impressions from the border. Elytra oval (7·2 × 3·9 mm.), convex, lightly and evenly rounded on sides; basal border joining lateral border without interruption at humeral angles; striæ strongly impressed, six inner ones attaining base, seventh strongly impressed, rising from lateral channel a little behind shoulder; 1st and 2nd interstices about equal, narrow, narrower and more convex on apical declivity, 3rd wide, not narrower or more convex on apical declivity, 4th and 6th narrow, 5th and 7th wide, 9th narrow, seriate-punctate, 10th long and very narrow. Prosternum bordered on anterior margin; intercoxal part with basal declivity rounded; mesosternum with intercoxal declivity widely and very lightly concave; episterna with concavity deep and punctulate; metasternal episterna short. Basal ventral segment punctate, three apical segments punctate, the puncturation near the anterior margin and extending across the segments. Length 13, breadth 3·9 mm.

Hab.—Nelson; Western District of Victoria (Blackburn).

A remarkable and isolated species quite aberrant in the genus *Sarticus;* the interstitial sculpture of the elytra distinguishes it decidedly from all other species of *Sarticus* and *Notonomus*. The prothorax and the elongate tenth elytral interstice suggest affinity to *Notonomus*, while the ventral segments are those of *Sarticus*. It is, I consider, more allied to *Notonomus mediosulcatus*, Chaud., than to any other described Australian species, but the affinity between these species is remote; so much so, that, even if the subgenus *Adetipa*, which Castelnau founded on *N. mediosulcatus*, were recognised (as I have no doubt it will be by specialists sooner or later), *S. impar* would hardly come into it. Its reference to *Sarticus*, I regard as preferable to resuscitating the subgenus *Adetipa*, where it would be, in any case, only doubtfully more in place than in *Sarticus*. A ridgid specialist would doubtless recognise as subgenera *Adetipa* and *Coronocanthus*; but, if this course be adopted, then named groups would be required forS *articus blackburni*, Sl., *S. impar*, *Notonomus molestus*,* Chaud., (and allied species), and probably *N. miles*, Casteln.; in fact, once admit subgenera, and a desire to give uniformity to classification seems to demand that each fairly distinct species, or group of species, shall receive a generic cognomen till an ordinary mind is bewildered by a numerous array of genera which no one without a special (and usually artificial) system can differentiate from one another.

SARTICUS CYANEOCINCTUS, Chaud.

Feronia (Steropus) cyaneocincta, Chaud., Bull. Mosc. 1865, ii. p. 97: *F. (Pterostichus) azureomarginata*, Casteln., Trans. Roy. Soc. Vict. viii. 1868, p. 215: *F. (Steropus) saphyreomarginata*, Casteln., *l.c.* 222: *Sarticus saphyreomarginatus*, (Casteln.) Chaud., Ann. Mus. Civ. Genov. vi. 1874, p. 595: Sloane, Proc. Linn. Soc. N.S.W. 1889, (2) iv. p. 505.

The name *S. cyaneocinctus*, Chaud., must stand for this species, being the earliest. Chaudoir, who latterly regarded *Sarticus* and *Homalosoma* as both merely subgenera of *Feronia*, considered his name preoccupied by *Homalosoma cyaneocincta*, Boisd.; but now that the old subgenus *Homalosoma* is recognised as a valid genus (*Castelneaudia*), this synonymy cannot be maintained.

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* The subgenus *Ternox* has been proposed by Motschusky for this species.

SARTICUS CORADGERI, n.sp.

Elliptical-oval, robust, convex; prothorax strongly rounded on sides and at posterior angles; elytra fully crenulate-striate, interstices convex, third tripunctate; three apical ventral segments finely punctate on each side. Black.

Head convex; eyes prominent. Prothorax transverse (4·3 × 5·1 mm.), convex; sides evenly rounded; apex lightly emarginate; border wide, strongly reflexed at anterior angles, becoming explanate at posterior angles; lateral basal impressions wide and deep; space between basal impressions convex, but below plane of disc; median line lightly impressed, ending in an elongate fovea posteriorly. Elytra oval (10·5 × 6 mm.), lightly convex on disc; humeral angles rounded; apical sinuosities lightly marked; striæ deep, coarsely crenulate, the puncturation obsolete on apical declivity; 7th stria strongly marked and closely punctate; interstices convex, 9th much narrower than 8th on basal half; lateral border widely reflexed, wide and carinate at humeral angles. Three apical ventral segments with a lightly impressed finely punctulate space on each side. Length 15·5-18, breadth 5·7-6·5 mm.

Hab.—N.S.W.: Inverell (Coll. Sloane; several specimens given to me by Mr. W. S. Duncan).

Resembling *S. aubei*, Casteln., but readily differentiated by its strongly crenulate elytral striæ, 8th interstice more convex, much wider in proportion than the 9th. From *S. macleayi*, Sl., it differs by size larger; prothorax less narrowed to base; mesosternal episterna impunctate, &c.

SARTICUS OBESULUS, Chaud.

Feronia (Steropus) obesula, Chaud., Bull. Mosc. 1865, ii., p. 99: *Sarticus orbicollis*, Motsch., *l.c.*, p. 266: *Feronia (Steropus) saphyripennis*, Casteln., Trans. Roy. Soc. Vict. viii., p. 223, 1868; *F. (S.) olivieri*, Casteln., *l.c.*, p. 223.

A variable species from the coastal districts of Victoria. (1) Typical form black, with very obscure purple reflections near lateral margin and on apical declivity (Geelong; J. F. Mulder). (2) ♂. With the disc of elytra more depressed, the purple colour brighter and overspreading more of the surface (3) Elytra æneous (Grampian Mountains; Best), Nelson; (Blackburn).

♂. Prothorax transverse (4·2 × 5·5 mm.), wide at base, strongly rounded at sides; elytra ovate (10 × 6·3 mm.); interstices convex on disc, depressed towards apex; 7th and 8th interstices hardly divided by a stria, thus giving the elytra a smooth appearance near sides. Length 15-17, breadth 5·1-6·4 mm.

I have followed Chaudoir in placing *F. olivieri*, Casteln., under *S. obesulus*. This seems likely to be correct, because Castelnau has said *F. olivieri* was found at Melbourne and Adelaide, and *S. obesulus* is a Melbourne species, though I do not know that it has been found at Adelaide.

SARTICUS ESMERALDIPENNIS, Castelnau.

Feronia (Steropus) esmeraldipennis, Casteln., Trans. Roy. Soc. Vict. viii., p. 223, 1868.

Robust, convex. Black, with an æneous or viridescent tint on elytra. Prothorax transverse (4·3 × 5·1 mm.), widest at middle, evidently narrowed to base; sides arcuate; apex (3·2 mm.) hardly emarginate; base 3·6 mm. in width between posterior marginal punctures; border narrow on anterior part of sides, becoming wider posteriorly, but not explanate before basal foveæ. Elytra oval (10 × 6·1 mm.), convex, strongly and fully striate; striæ punctate, hardly so near apex, 7th and 8th well marked, strongly punctate; interstices 1-7 roundly convex, not depressed near apex; lateral apical sinuosities strongly developed. Length 14-17, breadth 4·8-6·4 mm.

Hab.—Vic.: Mildura (French), Border of South Australia (on authority of Mr. French)—South Australia (Blackburn),

The name *S. esmeraldipennis*, Casteln., is applicable to this species which seems to range over the north-western parts of Victoria, and to extend as far as Adelaide. I regard it as quite distinct from *S. obesulus*, Chaud., and therefore dissent from

Chaudoir's opinion that *S. esmeraldipennis* is a synonym of *S. obesulus*. Castelnau's statement, that the prothorax of *S. esmeraldipennis* is longer than that of his *Feronia saphyripennis*, characterises this species and fixes its identity.

I note it as differing from *S. obesulus* by form narrower; prothorax less transverse, less strongly rounded on sides, narrower at apex and base; apex less emarginate; lateral border less widely explanate on posterior half; elytra more nitid, more convex, more strongly declivous on sides and apex; interstices more convex posteriorly, particularly at beginning of apical declivity; 6th and 7th striæ much more strongly impressed, more strongly punctate, 8th stria punctate between the ocellate punctures; lateral apical sinuosities far more strongly developed.

SARTICUS DAMPIERI, n.sp.

♀. Robust, oval, convex; prothorax lightly transverse, border very wide and reflexed posteriorly; elytra oval; deeply and fully crenulate-striate, interstices convex, 3rd 4-punctate. Black, iridescent (with a rather virescent tinge).

Head rather large (2·3 mm. across eyes), convex, smooth. Prothorax transverse (3·2 × 3·65 mm.), lævigate, convex, lightly declivous to base; sides evenly rounded; apex truncate, finely and continuously bordered; lateral border rather wide and reflexed anteriorly, very wide and strongly reflexed posteriorly; basal foveæ deep; median line strongly impressed, punctiform at posterior extremity. Elytra oval (7·7 × 4·8 mm.), convex; inner humeral angle well marked; striæ deep, strongly crenulate, seventh well marked and strongly crenulate, third 4-punctate, the posterior puncture on apical declivity; interstices convex, not depressed posteriorly; lateral border strongly reflexed; lateral apical sinuosities strongly developed. Prosternum with a narrow entire border along anterior margin. Mesosternum with intercoxal declivity almost vertical, lightly and widely concave, concavities of episterna strongly punctate. Metasternal episterna punctulate. Ventral segments lævigate, nitid; first punctulate; second with two or three punctures near sides; 3rd impunctate; three apical segments with a row of fine punctures along apical margin on each side. Length 12·5, breadth 4·8 mm.

Hab.—N.W.A.: Roebuck Bay (Coll. Sloane, received from Mr. French).

Rather a distinct species which I place next *S. civilis*, Germ., from which it differs by the prothorax more narrowed to base and with the border much wider at basal foveæ; elytral interstices more convex, particularly above apical declivity, the virescent tinge of the elytra and prosternal episterna. Compared with *S. habitans*, Sl., to which it has some resemblance, it differs by prothorax longer, not so wide, narrower at apex and at base; the elytra iridescent, with inner humeral angle marked, 3rd interstice 4-punctate, 9th interstice narrower in comparison with 8th; 2nd and 3rd ventral segments not punctulate, &c. If the presence of *the 4th puncture on the apical declivity of the 3rd elytral interstice* be a constant character, it would in itself differentiate *S. dampieri* from all the species known to me. *S. brevicornis*, Blkb., has the 3rd interstice 4-punctate—the position of the posterior puncture not stated—but *S. dampieri* differs evidently from the description of *S. brevicornis* by the strongly crenulate striæ and convex interstices of the elytra.

SARTICUS HABITANS, Sloane.

Proc. Linn. Soc. N.S.W. (2) iv. p. 508, 1889.

It is characteristic of *S. habitans* to have the elytra with the inner humeral angles open (this is caused by the lateral border being very narrow at its point of junction with the basal border), the 8th and 9th interstices convex, and the 8th stria strongly punctate. I have said in my description that the 8th interstice is not wider than the 9th, but this is inaccurate; the 9th interstice, though wide and convex, is not as wide as the 8th.

SARTICUS MACLEAYI, Sloane.

Proc. Linn. Soc. N.S.W. (2) iv. p. 502, 1889.

The description of this species requires amendment in some particulars; and being founded on a single specimen (♂) in my possession, it will be useful to compare it with *S. habitans*, Sl., to which it is more nearly allied than I formerly thought.

Dorsal striæ of elytra crenulate; prosternum with apex bordered; mesosternal episterna punctate, metasternal episterna *with a few punctures; legs long, femora narrow. Differs from S. habitans* (♂) by eyes less convex; prothorax narrower (3·3 × 3·8 mm.), widest a little before middle; evidently more narrowed to base (2·75 mm. between posterior marginal punctures), border narrower; elytral striæ narrower and more finely crenulate; three apical ventral segments with a row of rather strong punctures extending across each of them near anterior margin; femora less stout. Length 13·3, breadth 4·75 mm.

Hab.—N.S.W.: Coonabarabran (Sloane).

SARTICUS COOKI, n.sp.

Oval, convex. Head large (2·4 mm. across eyes); prothorax strongly rounded on sides; elytra oval, convex, striæ crenulate, interstices lightly convex on disc, depressed on apical and lateral declivities, 3rd tripunctate, tarsi with 5th joint spinulose beneath. Black; elytra bluish, nitid in ♂, opaque in ♀.

♂. Head convex; eyes large, prominent. Prothorax broader than long (3·1 × 3·7 mm.), convex; sides strongly rounded; border reflexed, moderately wide on anterior part of sides, becoming wider backwards from anterior marginal puncture, explanate and circumscribing the lateral basal foveæ towards base, narrow and entire on apex; middle of base not bordered; median line ending in a punctiform impression at posterior extremity. Elytra oval (7·2 × 4·6 mm.), convex; striæ shallow, rather finely crenulate, the crenulation almost obsolete on apical declivity, 7th stria lightly impressed, 8th lightly impressed, interrupted by the punctures of 9th interstice, hardly crenulate between these punctures, 7th, 8th and 9th interstices depressed (not at all convex) on basal half; lateral apical sinuosities weak—short but distinct. Prosternum bordered on apex; mesosternum deeply concave between coxæ; concavity of episterna finely punctate; metasternum with outer marginal border feebly developed or obsolescent; episterna quadrate, punctulate. Ventral segments: three basal punctate (2nd and 3rd closely and finely), puncturation obsolescent on three apical segments.

♀. Differing by elytral interstices more depressed and opaque. Length 11·5-12·3, breadth 4·4-4·6 mm.

Hab.—Neighbourhood of Sydney (Como; Froggatt).

Very closely allied to *S. monarensis*, Sl., but I think entitled to rank as a distinct species; the differences from *S. monarensis* that I note are the elytra bluish, more convex in ♂, more rounded on sides; the interstices in ♂ less convex, especially on apical declivity; tarsi with onychium spinulose beneath. From *S. civilis*, Germ., it differs by colour; smaller size; eyes more prominent; elytra with interstices less convex near apex; metasternal episterna shorter; three apical ventral segments without perceptible puncturation.

Genus PSEUDOCENEUS.

Tschitschérine, Hor. Soc. Ent. Ross., xxv, 1891: *Leptopodus*, Chaudoir and others.

When M. Tschitschérine founded the genus *Pseudoceneus*, he did not diagnose it, but merely indicated its position in his table of Oceanic genera. According to his table the following will be the characters assigned to *Pseudoceneus*:—

Tooth of mentum emarginate; palpi more or less cylindrical; prothorax with one rather weak impression on each side of base; elytra margined at base, 3rd interstice 3-punctate; prosternal episterna lævigate; ventral segments not transversely sulcate. I would add—winged; elytra with a striole at base of 1st interstice, two anterior punctures of 3rd interstice near 3rd stria, posterior puncture near 2nd stria.

M. Tschitschérine says the type of *Pseudoceneus* is *Argutor holomelanus*, Germ.; but with this I cannot agree. It seems that European coleopterists have ascribed the name *Argutor holomelanus* to some species other than that which Germar described under this name; for Chaudoir referred *A. holomelanus* to his genus *Leptopodus*, to which he also referred *Feronia (Pœcilus)* *iridipennis*, Casteln.,* which is undoubtedly a species of *Pseudoceneus.* A reference to Germar's description of *Argutor holomelanus* shows that it is a species with the elytra of about the same width as the prothorax, while the species of *Pseudoceneus* have the elytra so decidedly wider than the protharax that this feature alone precludes *A. holomelanus* from being a member of the genus. There seems no doubt but that *A. holomelanus* is a species of *Simodontus.* The description suits a species of *Simodontus* sent to me from Adelaide by the Rev. Thos. Blackburn under the name of *A. holomelanus* so well that I agree with his identification.† It will be as well to note here that Germar's statement "Thorax latitudine haud brevior" is manifestly erroneous. He gives the size of the species as "4 × 1¾ lin."; if, however, we take the prothorax as a little narrower than the elytra, and the elytra as described ("thorace latitudine et illo sesqui longiora") it would give 4 lines as the length of the prothorax and elytra without the head (1 line in length in my specimen). In the specimen before me the prothorax measures 2 × 3 mm. I would further add that, by a slip in Germar's description, the punctures of the 3rd elytral interstice are ascribed to the 2nd interstice.

The late H. W. Bates referred *Pterostichus sollicitus*, Erichs., to *Leptopodus;*‡ and it appears, from data supplied to me by Mr. A. M. Lea, that the species he referred to was one that seems identical with the widely spread species I regard as *Pœcilus iridipennis*, Casteln. If Bates's identification of *Pt. sollicitus*, Erichs., be correct, I expect this name must supercede *P. iridipennis* or *P. iridescens* of Castelnau; however, I hesitate to refer Erichson's name to a winged species in the face of his statement that it was apterous.

There seem to be four species referable to this genus, viz., *Feronia (Pœcilus) iridipennis*, Casteln.; *F. iridescens*, Casteln.;

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* Ann. Mus. Civ. Genov. vi. p. 600, 1874.

† *Vide* note by Rev. Thos. Blackburn in these Proceedings, 1889 (2), iv., p. 730.

‡ Cist. Ent. ii. 326, 1878.

F. interioris, Casteln.; and *F. subgagatina*, Casteln. Of these I believe I have recognised two which may be distinguished from one another thus:—

Elytra with interstices depressed, inner humeral angle open..	*P. iridipennis.*
Elytra with interstices convex, inner humeral angle sharply marked...	*P. subgagatinus*(?)

PSEUDOCENEUS IRIDIPENNIS, Casteln.

Feronia (Pœcilus) iridipennis, Casteln., *l.c.*, p. 217.

Provisionally I attribute to this species all the forms known to me with the elytral interstices depressed, but would draw attention to the varying width of the base of the prothorax, which leads me to suppose I have more than one species before me. I append some measurements:—

(1) ♀. Length 10; proth. 2·5 × 2·85, apex 2·15, base 2·5; el. 6·5 × 4·3 mm. *Loc*—Neighbourhood of Melbourne (Sloane).

(2) Length 11·5; proth. 2·5 × 3, apex 2·1, base 2·7; el. 6·8 × 4·4 mm. *Loc.*—Mulwala, Murray River (Sloane).

(3) ♀. Length 11·5; proth. 2·75 × 3·2, apex 2·2, base 3; el. 7·1 × 4·5 mm. *Loc.*—Sydney (Sloane).

I have suspected the Melbourne form may be *Feronia (Pœcilus) iridescens*, Casteln., more especially as I have it noted as identical with *Calathus iridescens* (Macleay, W. S., MSS.) of the Howitt Collection. If this be *P. iridescens*, Casteln., then probably the Murray River species is *P. iridipennis*, Casteln. Possibly the Sydney form may represent *P. interioris*, Casteln., but this species cannot be identified except from specimens from the Paroo River, the original locality.

It is remarkable and worthy of note that Messrs. Blackburn,[*] Tschitschérine,[†] and myself[‡] have all independently arrived at the conclusion that *Pœcilus iridescens*, Casteln., (of which the type is lost) was a species of *Loxandrus;* but subsequent consideration convinces me that this is a guess, and that the evidence available, which is very slight, leads to the conclusion that *P. iridescens* is closely allied to, if not identical with, *P. iridipennis.*

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[*] Proc. Linn. Soc. N.S.W., (2) iv., p. 731, 1889, and (2) vii., p. 95, 1892.

[†] Hor. Soc. Ent. Ross., xxv., 1891.

[‡] Trans. Roy. Soc. S. Aust., xix., p. 129, 1895; and Proc. Linn. Soc. N.S.W., xxiii., p. 460, 1898.

Genus CHLÆNIOIDIUS.

There is some synonymy amongst the species attributed to this genus, all of which I have seen, and reduce to three, which may be tabulated as under :—

Black.	
Elytral interstices depressed for whole length.......	*C. prolixus*, Erichs.
Elytral interstices convex, particularly at apex...	*C. pœciloides*, Chaud.
Upper surface green............	*C. herbaceus*, Chaud.

CHLÆNIOIDIUS PROLIXUS, Erichson.

Wiegm. Archiv, 1842, i., p. 127; Chaud., Bull. Mosc., 1865, ii., p. 110: *C. planipennis*, Macl., Trans. Ent. Soc. N.S.W., ii., p.109, 1871 : *Pœcilus sulcatulus*, Macl., Proc. Linn. Soc. N.S.W., (2) iii., p. 476, 1888.

I have examined the types of Macleay's species, *C. planipennis* and *P. sulcatulus* (in the Australian and Macleay Museums respectively), and have found them identical with *C. prolixus.* I have also seen the type of *Feronia (Pœcilus) funebris*, Casteln., in the Howitt Collection, and consider it, but without comparison, a large specimen of *C. prolixus.*

Hab.—Australia (universal) and Tasmania.

CHLÆNIOIDIUS PŒCILOIDES, Chaudoir.

Bull. Mosc., 1878, lii., p. 57 : *Chlænioidius irideomicans*, Tschitsch., Hor. Soc. Ent. Ross., xxv., 1891.

I have already suggested this synonymy (*vide* these Proceedings, (2) ix., p. 410, 1894).

Hab.—Q. : Townsville (Dodd).

CHLÆNIOIDIUS HERBACEUS, Chaudoir.

Bull. Mosc., 1865, ii., p. 111; Ann. Mus. Civ. Genov., vi., p. 600, 1874: *Feronia (Pœcilus) resplendens*, Casteln., Trans. Roy. Soc. Vict., viii., p. 217, 1868: *Pœcilus chlænioides*, Macl., Proc. Linn. Soc. N.S.W., (2) iii., p. 476, 1888.

After examining the type of *P. chlænioides* in the Macleay Museum, and comparing it with *C. herbaceus*, I found no difference.

Hab.—Australia, widely distributed.

Genus LOXANDRUS.

Table of Australian Species known to me.

i. Eyes small, not prominent, widely separated from buccal fissure beneath. Apterous.
  a. Black................................ *L. micans*, Blkb.
  aa. Reddish-brown................................ *L. brunneus*, Sl.
ii. Eyes large, prominent, not distant from buccal fissure beneath. Winged.
  b. Prothorax wholly lævigate.
    c. Prothorax with lateral border narrow, not wide at posterior angles or bearing posterior marginal seta.................. *L. australiensis*, Sl.
    cc. Prothorax with lateral border wide posteriorly and bearing the posterior marginal seta at basal angles. (Lateral channel wide and reaching base).
      d. Form elongate; prothorax with base and apex of equal width................................ *L. longiformis*, Sl.
      dd. Form oval; prothorax much wider across base than apex...................... { *L. quadricollis*, Sl. / *L. subviridescens*, Macl. }
  bb. Prothorax with base punctate in and near lateral basal impressions.
    e. Prothorax lightly rounded on sides..... { *L. rufilabris*, Casteln. / *L. lævigatus*, Macl. }
    ee. Prothorax strongly rounded on sides (base very wide)................................ *L. amplicollis*, Sl.

The species I have not identified are *L. gagatinus*,* Casteln., *L. crenulatus*, Macl.,† and *L. lævicollis*, Blkb.

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* For a note on *L. gagatinus*, see notes on *L. subiridescens*, postea (p.628); the other two species I pass over for the present.

† I have seen the type of *Pterostichus crenulatus*, Macl., and have noted that it is a species of *Loxandrus*.

LOXANDRUS BRUNNEUS, n.sp.

Elliptical-oval, depressed. Head small, eyes small, depressed, distant from buccal fissure; prothorax quadrate-cordate, basal angles not marked; elytra depressed on disc, strongly punctate-striate, scutellar striole wanting, 3rd interstice unipunctate a little before middle near 2nd stria. Reddish-brown, iridescent.

Head small (1·7 mm across eyes), nitid, lævigate; vertex convex; front rather depressed, without interantennal impressions; sides swollen and lightly narrowed posteriorly behind eyes. Prothorax nitid, broader than long (2·5 × 2·8 mm.), depressed, lightly declivous to sides on anterior two-thirds; sides lightly arcuate, lightly and obliquely narrowed to base (2·15 mm.), more strongly and roundly narrowed to apex (1·9 mm); apex emarginate; anterior angles lightly advanced, obtuse; basal angles not marked; posterior marginal seta free of border at basal angle; border narrow on sides, very fine but entire on apex and base; median line finely impressed; lateral basal impressions long, linear. Elytra oval (5·6 × 3·5 mm.), depressed, strongly declivous on sides from 6th interstice and to apex; apex rounded without lateral sinuosities; lateral border rather widely reflexed; striæ strongly impressed, closely punctulate; interstices nitid, lightly convex, strongly so and narrow near apex, 9th seriate-punctate, the punctures widely placed along sides. Prosternum with episterna finely punctulate; intercoxal part small, finely bordered on base, rounded on basal declivity; mesosternum with intercoxal declivity deeply concave; episterna closely punctate; metasternum punctate on each side near basal angle; episterna closely punctate. Ventral segments punctate, the puncturation strong and close on basal segments, becoming finer towards apex near sides, and finer or obsolete in middle of segments. Length 9-10, breadth 3·3-3·6 mm.

Hab.—N.S.W.: Darling River (Wilcannia; Helms, Coll. Sloane).

A very distinct species differentiated at once from all other described Australian species by its brownish colour. Its affinity is to *L. micans*, Blkb., and these two species form a very distinct group in the genus, characterised by the eyes small and distant from the buccal fissure. *L brunneus* may be readily distinguished from *L. micans* (also from the Darling River) by its smaller size; colour; head more narrowed behind eyes, the "temples" more swollen; prothorax proportionately longer, less strongly rounded on sides, more narrowed to base, basal angles less strongly rounded, &c.

LOXANDRUS QUADRICOLLIS, n.sp.

Oblong-oval, convex. Eyes large, prominent, not distant from buccal fissure beneath. Prothorax lævigate, subquadrate (2·6 × 2·8 mm.) with sides rounded, strongly narrowed to apex (1·75 mm.), very lightly so to base (2·5 mm.); basal angles widely rounded; base truncate, bordered; lateral border wide and bearing the posterior marginal seta at basal angles; lateral channel wide, opaque, extending to base; median line light; lateral basal impressions elongate, linear; spaces between these and lateral channel impunctate, a little convex. Elytra ovate (6·5 × 3·85 mm.); inner angle at shoulder formed by junction of lateral and basal borders open; striæ deep, crenulate; interstices lightly convex, 3rd unipunctate near 2nd stria a little before middle. Mesosternal episterna, metasternum on each side and its episterna punctate. Ventral segments rugulose-punctate. Black, iridescent; legs black, tarsi piceous; antennæ dark piceous. Length 10, breadth 3·85 mm.

Hab.—N.S.W.: Mulwala, Urana, and Junee (Sloane)—Vic.: Swan Hill (French).

The description given above is founded on specimens from the Urana District. For the validity of *L. quadricollis* as a species distinct from *L. subiridescens*, Macl., reliance is placed on its larger size; more robust form; differently shaped prothorax, which is much wider at the base and more strongly narrowed to the apex, more evenly rounded on the sides, hardly at all narrowed to the base, &c.

LOXANDRUS SUBIRIDESCENS, Macl.

♀. *Pœcilus subiridescens*, Macl., Trans. Ent. Soc. N.S.W., ii., p. 110, 1873: ♀. *P. atronitens*, Macl., *l.c.*, p. 110: *Platynus nitidipennis*, Macl., *l.c.*, p. 111.

I have carefully examined and compared the types in the Australian Museum of Macleay's species given above, and found them all conspecific. *P. subiridescens* and *P. atronitens* are founded on the ♀, *Platynus nitidipennis* on the ♂. *L. subiridescens* being the name first in order, I adopt it for the species, at least provisionally, for I believe it will prove synonymous with *L. gagatinus*, Casteln., from Tasmania; but, not having seen it from Tasmania, cannot feel absolute certainty on this point; the description of *L. gagatinus* is useless unless one had Tasmanian specimens.

L. subiridescens has, from Macleay's types, the prothorax narrowing to the base, free from punctures near the basal angles, these rounded. Length (after Macleay) 4-4½ lines.

This species is common on the Murray River. A specimen (♂) from Mulwala, in my collection, which I compared with the type of *Platynus nitidipennis*, Macl., and found the same, has the dimensions: length 8·3; proth. 2 × 2·3, apex 1·7, base 2·1; el. 5 × 3·15 mm.

It is distinguished readily from *L. rufilabris*, Casteln., by the absence of puncturation on the prothorax at sides of base, and is the species I have called *L. iridescens* in my descriptions of *L. australiensis* and *L. longiformis*.

LOXANDRUS RUFILABRIS, Casteln.

Pœcilus rufilabris, Casteln., Trans. Roy. Soc. Vict. viii. p. 219, 1868.

I ascribe the name *L. rufilabris*, Casteln., to a Queensland species sent to me by Mr. F. P. Dodd from Townsville, which seems to agree better with Castelnau's description than any other species I have seen.

Elliptical-oval, lightly convex; eyes large, convex, near buccal fissure beneath. Prothorax lightly transverse (2·3 × 2·75 mm.), widest about middle, lævigate, lightly punctate on each side of base; sides lightly and almost evenly rounded, lightly narrowed to base; apex (1·8 mm.) narrower than base (2·15 mm.), emarginate; anterior angles rather prominent; basal angles not marked; posterior marginal seta at basal angle; border narrow on sides, not wide at basal angles, entire on apex, obsolete on base; lateral basal impressions long, narrow; spaces between these impressions and lateral margins depressed, punctate. Elytra oval (6·2 × 3·8 mm.), rounded on sides; striæ strongly crenulate; interstices lightly convex, 3rd unipunctate in middle near 2nd stria. Black, iridescent, often with faint bluish reflections on upper surface; under surface nitid, dark piceous; femora dark piceous, tibiæ piceous; tarsi, palpi and antennæ reddish, 3rd and 4th joints of antennæ piceous; labrum piceous. Length 10, breadth 3·8 mm.

LOXANDRUS LÆVIGATUS, Macleay.

Pterostichus lævigatus, Macl., Proc. Linn. Soc. N.S.W., (2) iii., p. 479, 1888.

♀. *L. lævigatus* only differs from *L. rufilabris*, Casteln., (as identified by me), by size smaller, form wider; prothorax proportionately wider (2 × 2·4 mm.), more depressed (especially towards base), more dilatate on sides at widest part; border similar, continuous across base; elytra less convex, wider (5·3 × 3·25 mm.), humeral angles more widely rounded, inner angles formed by junction of basal and lateral border more open, striæ more finely crenulate, interstices less convex. Length 9, breadth 3·25 mm. (Prothorax 2 × 2·4, apex 1·5, base 2 mm.).

Hab.—N.W. Australia.

The note given above is founded on a specimen from the Macleay Collection (one of those brought by Mr. Froggatt from King's Sound). A specimen given to me by Mr. C. French, as coming from Central Australia, is larger (length 10 mm.), but I cannot differentiate it from *L. lævigatus;* this specimen could represent *L. rufilabris*, Casteln., as well as the species to which I have applied that name. From *L. subiridescens*, Macl., *L. lævigatus* differs by the prothorax more depressed and punctate near base, lateral border narrower and not bearing a large puncture from which the posterior marginal seta springs at the basal angles.

Two specimens (♂♀) from Townsville, Queensland, received from Mr. F. P. Dodd, have the prothorax shorter (♀ 1·8 × 2·3, apex 1·5, base 1·9 mm.), more strongly rounded on sides; lateral apical sinuosities of elytra weaker; it is perhaps a closely allied species, but I refrain from describing it without more data as to the amount of variety in shape of prothorax in *L. lævigatus*.

LOXANDRUS AMPLICOLLIS, n.sp.

Elliptical-oval, robust. Eyes large, prominent, not distant from buccal fissure beneath; prothorax wide at base, punctate on each side of base; elytra convex, fully crenulate-striate; interstices convex, 3rd unipunctate; lateral apical sinuosities feebly developed. Black, nitid; legs black; tarsi and antennæ piceous; labrum dark piceous.

Prothorax wide (2·5 × 3·15 mm.), convex, much wider across base (2·65 mm.) than apex (2 mm.); sides strongly rounded; apex emarginate; anterior angles widely bordered; base truncate; basal angles rounded; border wide on sides, wider towards base, bearing on edge at basal angles the posterior marginal puncture; median line fine. Length 10-11, breadth 3·9-4 mm.

Hab.—Q.: Townsville (Dodd), Gulf of Carpentaria (given to me by Mr. French; Coll. Sloane).

Closely allied to *L. rufilabris*, Casteln., but of stouter build; elytra much more convex; the essential difference is in the shape of the prothorax, which is much wider in proportion to the length, more strongly rounded on sides and far wider across base. From *L. lævigatus*, Macl., it differs by form more convex; prothorax more strongly rounded on sides, much wider at base; elytra less strongly sinuate on each side of apex, interstices much more convex. The punctate prothorax separates it from *L. quadricollis*, Sl.

Tribe PLATYNINI.

From Horn's table of the *Harpalinæ bisetosæ* in his "Genera of Carabidæ," the following features are taken as diagnostic of the *Platynini* :—

Mandibles without a setigerous puncture in the groove on outer side; margin of elytra not interrupted posteriorly, and without an internal plica; front normal; penultimate joint of labial palpi bisetose; posterior coxæ contiguous; head not prolonged behind eyes, neck not semiglobose; elytra obliquely sinuate at tip.

Horn divides the *Platynini* into three groups, two of which are represented in Australia and are separable (after Horn) thus :—

Eighth elytral stria distant from margin, not deeply impressed. *Platynides.*
Eighth elytral stria confluent with margin in its basal half, deeply impressed and attaining suture .... *Perigonides.*

Group PLATYNIDES.

The Australian genera of the group *Platynides* may be tabulated as follows (following Horn's table of genera) :—

Ungues more or less serrate. Mentum toothed. (Tarsi hairy above. Elytra without dorsal punctures) .... *Pristonychus.*
Ungues not serrate. Elytra with dorsal punctures. Mentum toothed.
  Tarsi with 4th joint not bilobed .... *Platynus.*
  Tarsi with 4th joint bilobed .... *Colpodes.*

Pristonychus has only one described Australian species, viz., *P. australis*, Blackburn (1888), which is found in Western Australia, South Australia, and Victoria.*

Genus PLATYNUS.

I tabulate the Australian species known to me as under :—

A. Elytra with 8th interstice not narrow and convex at apex.
  b. Prothorax transverse, strongly narrowed on sides to base and apex.
    c. Elytra viridiæneous with narrow testaceous margin; legs pale .... *P. marginicollis*, Macl.

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* This is probably an introduced species, viz., the European *P. complanatus*, which is said by Horn to be rather widely spread by commerce over the globe (Trans. Am. Ent. Soc. ix. 142). Mr. J. J. Walker has given me a specimen taken by him at Port Adelaide, which he considers *P. complanatus* (a species unknown to me in nature) and which I identify as *P. australis*, Blkb.

cc. Elytra obscure, legs fuscous............ ... *P. marginellus*, Erichson.

bb. Prothorax elongate (⅛ broader than long, after Blackburn), gently narrowed to base and apex...... .... *P. murrayanus*, Blkb.

AA. Elytra with 8th interstice narrow and convex at apex (size small).

d. Prothorax hardly narrowed to base, posterior angles obtuse; elytra with punctures of 3rd interstice minute. *P. queenslandicus*, Sl.

dd. Prothorax transverse, strongly narrowed to base, posterior angles marked; elytra with punctures of 3rd interstice large, foveiform.............. .. .. *P. cooki*, Sl.

The following notes deal with the species referred to *Platynus* in Masters' 'Catalogue,' Part i. (1885), and its 'Supplement,' Part i. (1895), but which have not been included in the foregoing table.

P. ambiguus, Erichs., is not a member of the genus. Its synonymy is *P. ambiguus*, Erichs. (1842) = *P. lophoides*, Chaud. (1854) = *Cyclothorax punctipennis*, Macl. (1871). The identity of *Cyclothorax punctipennis*, Macl., with *Platynus ambiguus*, Erichs., was published in 1874 by H. W. Bates in his paper on the "Geodephagous Coleoptera of New Zealand,"* and the synonymy of *P. lophoides*, Chaud., with the same species in 1894 by me.†

P. planipennis, Macl., *postea*, p. 633.

P. nitidipennis, Macl., is referable, not to *Platynus*, but to *Loxandrus*.‡

PLATYNUS MARGINELLUS, Erichson.

Wiegm. Arch. 1842, i. p.130: *Anchomenus nigro-æneus*, Newm., The Entomologist, 1842, p. 402.

I think there can be no doubt but that the Victorian species *Anchomenus nigro-æneus*, Newm., (brought from Port Phillip by Mr. Edmund Higgins) is identical with the Tasmanian species *Platynus marginellus*, Erichs.; and this is also the opinion of the Rev. Thos. Blackburn.§

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* Ann. & Mag. Nat. Hist., (4) xiii. (March-Aprill) 1874, p. 12.

† These Proceedings, 1894, (2) ix., p. 447.

‡ *Supra*, p. 628.

§ These Proceedings, 1889, (2) iv. p. 740.

It extends along the eastern coast of Australia at least as far north as Wollongong in New South Wales, where I have taken it.

Platynus planipennis, Macl., I do not know in nature, but the description suggests to me its probable identity with *P. marginellus* so strongly that I am unwilling to regard it as a valid species unless it be proved that the range of *P. marginellus* does not extend as far north as Gayndah, or a comparison of the type with *P. marginellus* discloses specific differences between them.

Loxocrepis lugubris, Motsch., (which is placed in Masters' 'Catologue' in *Colpodes*) seems to me a species of *Platynus*. I have been unable to satisfy myself of its identity with *P. marginellus*, but the description appears to me not inapplicable to that species; and I therefore suggest that it might be placed under *P. marginellus* with perhaps a little doubt. In this connection it may be noted that M. Tschitschérine has recently recorded the fact that Motschulsky's types are almost all lost,[†] so doubtless the determination of *L. lugubris* is wholly dependent upon the description.

PLATYNUS QUEENSLANDICUS, n.sp.

♀. Small, elliptical, depressed; prothorax subquadrate, a little wider at base than apex, basal angles obtuse; elytra much wider than prothorax, finely striate, 1st interstice with an elongate striole at base, 3rd with three minute punctures—anterior on course of 3rd, two posterior on course of 2nd stria. Brown (or piceous); prothorax with the explanate margins testaceous; elytra with 1st interstice and lateral margin (also part of 8th interstice) testaceous; legs fusco-testaceous; antennæ fuscous.

Head smooth, lightly and obliquely narrowed behind eyes, lightly convex between eyes, lightly and widely biimpressed between antennæ; eyes large, rather prominent but subdepressed (not protuberant and hemispherical). Prothorax broader than long (1·4 × 1·7 mm.), depressed; sides lightly rounded, widest about middle, almost equally narrowed to apex and base (but a little more lightly so to base); anterior margin lightly emarginate;

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[*] Hor. Soc. Ent. Ross. xxxv. 1892, p. 534.

anterior angles obtuse, not marked; base truncate in middle; basal angles roundly obtuse, not marked; lateral margins wide and explanate, not reflexed; lateral basal impressions distinct, wide, subrotundate; disc canaliculate, not declivous to middle of base. Elytra ovate (4·2 × 2·7 mm.), depressed; disc with a wide lightly depressed space on each side about posterior third (extending across 3rd, 4th and 5th interstices); apical curve oblique on each side, apex itself obtuse; striæ very lightly impressed, feebly crenulate; interstices flat, 1st and 3rd united at apex, 8th much wider than 9th on sides, narrow and rather convex near apex, 9th seriate-punctate; lateral border narrow, reflexed. Tarsi with 4th joint very small, a little emarginate at apex. Length 7, breadth 2·7 mm.

Hab.—Q.: Mackay. (Given to me by Mr. C. French; Coll. Sloane).

P. queenslandicus has little affinity to any previously described Australian species. *P. cooki*, Sl., is the only one from which it is not at once differentiated by its small size; but it is not at all closely allied to *P. cooki*, conspicuous differences being eyes far less protuberant and not hemispherical; prothorax less transverse, much less strongly narrowed to base; (the wide explanate margins very different from the narrower reflexed ones of *P. cooki*); punctures of 3rd elytral interstice minute and punctiform instead of large and foveiform. It seems more allied to *P. papuensis*, Sl., from New Guinea, of which I have no specimen for reference, but is quite distinct by size smaller, colour not black, &c.

Genus Colpodes.

In Masters' 'Catalogue' and 'Supplement' four species are referred to *Colpodes*, but only one, *C. mucronatus*, Macl., properly belongs to the genus. The others are (*a*) *Loxocrepis lugubris*, Motsch., dealt with above; (*b*) *Dyscolus australis*, Erichs., and *D. dilatatus*, which are not members of the tribe *Platynini*.*

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* Vide note by the Rev. Thos. Blackburn in these Proceedings, (2) vii., p. 85, 1892.

Group **Perigonides**.

The group Perigonides contains only the genus *Perigona* according to Horn; three Australian species are known to me.

Genus PERIGONA.

Siltopia, Casteln., Trans. Roy. Soc. Vict. viii. 1868, p. 127.

I tabulate the Australian species as under :—

Elytra unicolorous (yellow).................................. ....*P. tricolor*, Casteln.
Elytra bicolorous.
  Elytra with base (widely), suture, and margin (narrowly) reddish, rest of surface black.. ....*P. rufilabris*, Macl.
    Elytra pale testaceous, a narrow black strip along (but not touching) margin of apical curve ....*P. apicalis*, Sl.

PERIGONA TRICOLOR, Castelnau.

Siltopia tricolor, Casteln., *l.c.*, p. 127.

Castelnau referred his *Siltopia tricolor* to the *Morionini*, but Chaudoir, in his Monograph of the *Morionides*,* excluded it from that tribe as being a species of *Perigona*. I have a specimen from Wiseman's Ferry on the Hawkesbury River, N.S.W., which I have compared with the specimen of *Siltopia tricolor*, Casteln., in the Howitt Collection.

PERIGONA RUFILABRIS, Macleay.

Trechus rufilabris, Macl., Trans. Ent. Soc. N.S.W., ii., 1871, p. 114: *P. basalis*, Putz., Ann. Mus. Civ. Genov., iv., 1873, p.223.

I have examined the type of *Trechus rufilabris*, Macl., in the Australian Museum, and have found it to belong to the genus *Perigona*. A comparison of Macleay's description of *P. rufilabris* with Putzey's description of *P. basalis* convinces me of their identity.

PERIGONA AUSTRALICA, n.sp.

Pale testaceous, head black, elytra with a narrow blackish strip near margin of apical curve. Head with front rather strongly biimpressed; spaces between frontal impressions and base of antennæ narrow, convex; eyes large, convex, prominent. Prothorax transverse, subquadrate, widest rather before middle; sides lightly rounded, hardly narrowed to base; basal angles obtuse but a little marked; base truncate; border narrow, reflexed. Elytra ovate, widely and evenly rounded on apical curve; striæ obsolescent, only three inner ones faintly marked between 1st and 2nd discoidal punctures, 3rd interstice 3-punctate, 8th detaching itself from marginal channel about basal fourth, enclosing a wide, slightly raised interstice on apical curve. Length 3·1, breadth 1·35 mm.

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* Bull. Mosc., 1880, lv., p. 318.

Hab.—Q.: Mackay (given to me by Mr. C. French; Coll. Sloane).

Differs from the other two Australian species by smaller size and paler colour. The mandibles and labrum are pale-coloured.

Tribe **LEBIINI**.

PENTAGONICA DICHROA, n.sp.

Head black; prothorax yellow, margin more pallid; elytra sericeous-black, a narrow testaceous margin on sides; body black; legs pallid; antennæ fuscous, joints 2-4 lighter-coloured than others. Head convex, wide (1·25 mm. across eyes); neck condyliform. Antennæ with four basal joints glabrous, basal joint long and stout, nearly as long as two succeeding joints together; joints 2-4 cylindrical, second shortest, a little more than ½ length of 3rd,—this ⅓ longer than 4th and ¼ shorter than 5th.* Prothorax transverse (0·9 × 1·5 mm.), convex (basal part depressed), widest slightly before the middle; base widely and strongly lobate; apex bordered, very lightly and widely emarginate in middle; sides widely margined, the margin more explanate and forming a well marked but obtuse angle at widest part; the place of the posterior angles indicated by a slight wide dilatation of the margin a little nearer the basal lobe than the lateral angle; median line finely impressed. Elytra oval (3·8 × 2·5 mm.), convex, finely striate, minutely shagreened; shoulders widely rounded; humeral angles not marked; sides subparallel, lightly narrowed to the subobliquely truncate apex; striæ finely punctate under a lens; interstices depressed, 1st narrow, 2nd wide, depressed, 3rd a little raised, 3-punctate (anterior puncture near 3rd stria opposite posterior extremity of basal striole of 1st interstice, 2nd about middle of length near 2nd stria, posterior about midway between 2nd and apex near 2nd stria), 9th narrow, seriate-punctate; marginal channel narrow, reflexed; border and inflexed margin testaceous on sides. Length 5·8, breadth 2·5 mm.

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* The attention of students using Lacordaire's 'Genera' may be drawn to the erroneous manner in which the basal joints of the antennæ of *Pentagonica* are there described (after Schmidt-Goebel), what is called the 1st joint being merely the basal condyle of the 1st joint. Under *Rhombodera* (Reiche) in the 'Genera' will be found a good description of the basal joints of the antennæ in *Pentagonica*, with which it is synonymous. Le Conte's description of the antennæ of *Didetus* (synonymous with *Pentagonica*) as quoted in the 'Genera' is poor; he describes the 4th joint as moderately pubescent, in *P. dichroa* I consider the 4th joint may be called glabrous without inaccuracy.

Hab.—Q.: Mackay (sent by Mr. Turner to Mr. French, from whom I received it; Coll. Sloane).

Genus SCOPODES.

The Australian and Tasmanian species of *Scopodes* known to me may be tabulated as under:—

A. Prothorax with anterior angles not marked.
  B. Prothorax with two setigerous marginal punctures on each side.
    C. Prothorax with posterior marginal seta on each posterior angle.
      D. Prothorax wide between posterior angles, these explanate but not dentiform.
        e. Black...*S. tasmanicus*, Bates.
        ee. Head and prothorax bronzy, elytra dull bronze with sericeous-black patches..*S. rimosicollis*, Sl.
      DD. Prothorax with posterior angles dentiform.
        f. Black...*S. boops*, Erichs.
        ff. Metallic (of a bronzy hue)................. *S. sigillatus*, Germ.
        S. flavipes, Blkb.
    CC. Prothorax with posterior marginal seta on a small dentiform prominence about half-way between anterior seta and base. (Prothorax strongly narrowed to base; each elytron trifoveate).

g. Lateral border of prothorax decidedly dilatate and angulate to receive posterior marginal seta................................	*S. aterrimus*, Chaud. *S. sydneyensis*, Sl.

gg. Lateral border of prothorax very narrow and not dilated to receive posterior marginal seta.................*S. denticollis*, Macl.

BB. Prothorax with only the anterior marginal seta present. (Prothorax very strongly angustate posteriorly, base truncate—not lobate).

h. Prothorax strongly dentate at widest part; elytra finely and sparsely seriate-punctate................................ . ...*S. æneus*, Macl.

hh. Prothorax ampliate and subangulate (not dentate) at widest part; elytra substriate, the striæ not punctate........ ......*S. griffithi*, Sl.

AA. Prothorax with anterior angles subrectangular, marked but obtuse at apex. (Anterior margin wide, lightly emarginate)...*S. auratus*, Macl.

S. tasmanicus, Bates, I have taken in Victoria at Yarragon on the Gippsland Railway.

S. angulicollis, Macl., seems, from the description, as if it should be placed with *S. tasmanicus*, Bates, and *S. rimosicollis*, Sl.; it is too small to be either of these species, even if its prothorax be similarly shaped, a question I cannot determine from the imperfect description; the colour is not stated.

S. simplex, Blkb., seems allied to *S. tasmanicus*, Bates, but thoroughly distinct.

S. sericeus, Macl.—I have examined the type in the Australian Museum in comparison with *S. sigillatus*, Germ., and have considered it identical.

S. intermedius, Blkb., evidently goes with *S. sigillatus*.

S. rugatus, Blkb., seems to be allied to *S. sigillatus*.

S. intricatus, Blkb., may come into section "DD," but has the base scarcely lobed.

S. sexfoveatus, Macl., cannot be said to be described, but is evidently allied to *S. denticollis*, Macl.

S. fasciolatus, Macl., seems very near *S. auratus*, Macl. The description agrees with my specimens tabulated above as *S. auratus*, which originally came from Mr. Masters and were named by him.

S. lævis, Macl., is a species I do not know, nor can I suggest its position in the genus, for I cannot feel sure from the description whether the prothorax has the sides with *one* or with two setæ.

SCOPODES RIMOSICOLLIS, n.sp.

Head and prothorax of a dark metallic bronzy colour; elytra sericeous, dull bronze with black patches; under surface and legs black. Head wide (1·5 mm. across eyes), closely striolate between eyes. Prothorax hardly as wide as eyes, transverse (1·1 × 1·45 mm.), widest a little behind anterior angles, wide between posterior angles, depressed; surface vermiculate (sculpture close, intricate and covering whole upper surface); apex wide; anterior angles hardly marked, distant from head; sides curving shortly but decidedly from widest part to anterior angles, narrowing a little behind lateral angles, curving lightly outwards to posterior angles, these not dentate, sharply marked, rectangular (the summit slightly obtuse); base obliquely truncate from basal angles to peduncle, shortly lobate above peduncle; lateral border rather wide, forming a lightly marked setigerous angulate prominence at widest part, explanate and setigerous at posterior angles. Elytra wide, oval (3·1 × 2·3 mm.), subparallel on sides, subdepressed, substriate; 3rd interstice lightly 3-punctate. Length 4·7-5·3, breadth 2·15-2·3 mm.

Hab.—N.S.W.: Dunoon, Richmond River (Helms; Coll. Sloane).

Allied to *S. tasmanicus*, Bates, but differing by colour; prothorax wider, anterior and posterior lateral angles more prominent, surface more strongly rugulose, the basal part not defined by a linear impression but on same plane as and rugulose like the rest of the upper surface, median line hardly perceptible, &c. In general appearance it resembles *S. æneus*, Macl., the elytra having the same shape, but the prothorax is entirely different.

SCOPODES SYDNEYENSIS, n.sp.

Narrow. Black. Head large (1·1 mm. across eyes), narrow, lightly convex, smooth (sometimes a little rugose between anterior supraorbital setæ and smooth on front and vertex); clypeus convex and lævigate towards base. Prothorax narrower than head, small, cordiform (0·8 × 1 mm.), widest and angulate near apex, convex, not lobed at base; disc canaliculate; rather coarsely shagreened and minutely transversely striolate (the striolæ stronger near sides); anterior angles obsolete; sides roundly ampliate from neck to anterior lateral angles, obliquely (hardly roundly) and continuously narrowed to base; basal angles not marked; lateral border narrow, dilated to form a sharp setigerous angle at widest part, a similar angulate prominence a little more than midway to base, the course of the border behind the posterior setigerous angle almost continuous with the part in front of this angle. Elytra oval (2·15 × 1·5 mm.), convex, rather opaque, shagreened, not sericeous, sexfoveate, lightly striate; the striæ shallow, not clearly defined, not punctulate. Length 3·6-3·8, breadth 1·4-1·5 mm.

Hab.—N.S.W.: Sydney (three specimens occurred to me on sandy ground near Manly, 14th December, 1895).

Very closely allied to *S. aterrimus*, Chaud., but differing by size smaller; head smooth on front and vertex; prothorax narrower, more strongly and evenly angustate to base, less strongly and roundly narrowed behind posterior marginal prominence, surface less rugulose, lateral border narrower, posterior setigerous angles smaller. It may be not more than a variety of *S. aterrimus*, but I have thought it sufficiently distinct to receive a name.

SCOPODES GRIFFITHI, n.sp.

Upper surface æneous or cupreous; undersurface and legs black. Head hardly as wide as prothorax (1·35 mm.) across eyes, closely longitudinally striolate between eyes; front irregularly striolate anteriorly; clypeus closely longitudinally striolate. Prothorax cordate (1·2 × 1·4 mm.), roundly dilatate at anterior third, strongly angustate to base, convex, shagreened and transversely rugulose; apex wide, anterior angles not marked, widely rounded, distant from neck; border very narrow, not reaching quite to base, unisetigerous and forming a slight though hardly marked angle on each side at widest part; base truncate. Elytra oval (3·1 × 2·25 mm.), convex, sunbitid, shagreened, not sericeous, substriate; 3rd interstice with three fine punctures placed in shallow depressions. Length 6, breadth 2·25 mm.

Hab.—Tas.: Mt. Wellington (given to me by Mr. A. M. Lea, Government Entomologist for Tasmania, as having been taken by Mr. H. H. D. Griffith, "half-way to summit on marshy ground").

Can only be compared with *S. æneus*, Macl., amongst Australian species, but very distinct, and at once distinguishable by the sides of the prothorax not dentate at widest part, &c.

POSTSCRIPT *(added October 19th, 1903)*—

TACHYS NERVOSUS, n.sp.

Oval, robust. Testaceous. Each elytron 17-striate and without apical striole.

Head shagreened; a short slightly raised intramarginal frontal ridge extending backwards from base of clypeus on each side between anterior part of eyes; frontal longitudinal impressions feeble. Prothorax transverse, subdepressed, wider at base than at apex, rugulose—the rugæ transverse in middle of disc, longitudinal near apical and basal margins—sides lightly rounded on anterior three-fourths, sinuate posteriorly and meeting base at right angles; apex widely emarginate; anterior angles subprominent, obtuse (not advanced), base truncate on each side, widely but lightly produced backwards in middle; basal angles rectangular; marginal channel wide before posterior lateral sinuosity, narrow near basal angle, its inner margin subcarinate, more strongly so near base; lateral basal impressions wide, flat (not concave); a lightly impressed arcuate transverse impression defining the sublobate median part of base. Elytra convex, oval, wider than prothorax; 17 striæ on each elytron; lateral channel incurved at humeral angle to meet 10th stria; interstices forming narrow subequal ridges, 17th interstice ("*lateral interstice*") of normal width, convex, 4-setose (three of these setæ rising from pores on posterior half of interstice). Anterior tibiæ oblique externally above apex, a sharp triangular spur above the obliquity. Length 3·3, breadth 1·4 mm.

Hab.—Q. : Townsville District (Dodd).

This species is at once differentiated from all the described Australian Bembidiides by its multistriate elytra, which have the ordinary interstices from the 1st to the 8th inclusive divided into two narrow ridges. The form of the lateral interstice—with the position of its setigerous punctures,—and the junction of the lateral channel with the 10th stria (representing what would be normally the 5th interstice) indicate a relationship with *Tachys buprestioides*, Sl. Mr. F. P. Dodd sent me this strange species as taken by him at Ross River, 5½ miles from Townsville.

REVISION OF THE AUSTRALIAN CURCULIONIDÆ BELONGING TO THE SUBFAMILY *CRYPTORHYNCHIDES.*

By Arthur M. Lea, F.E.S.

Part VI.

Genus Perissops, Pascoe.

Journ. Linn. Soc., Zool. xi. 1871, p. 193.

Head convex, not concealed; ocular fovea variable. *Eyes* large or very large, finely faceted, subcontiguous or moderately distant. *Rostrum* moderately long or rather short, curved or almost straight, thin or thick and sexually variable. *Antennæ* moderately slender; scape inserted nearer apex than base of rostrum and shorter than funicle; two basal joints of funicle more or less elongate; club moderately long, sutures oblique. *Prothorax* more or less conical and transverse; ocular lobes prominent or not, base bisinuate. *Scutellum* small. *Elytra* closely applied to and outline continuous with that of prothorax. *Pectoral canal* wide and rather deep, terminated between intermediate coxæ. *Mesosternal receptacle* rather large, raised, emargination semicircular, base truncate, apices thin; cavernous. *Metasternum* shorter than the following segment; episterna distinct. Basal segment of *abdomen* as long as 2nd and 3rd combined, intercoxal process rather narrow, apex incurved; 3rd and 4th slightly produced backwards at sides, their combined length slightly more than that of 2nd and considerably more than that of 5th. Anterior *legs* moderately long, the others short; femora stout, dentate, feebly (especially the anterior) grooved, posterior not extending to apex of abdomen; tibiæ flat, curved, with a distinct subapical tooth in addition to the terminal hook; tarsi moderately long, 1st and 4th joints rather long and subequal. Elliptic or elliptic-ovate, strongly convex, non-tuberculate, winged.

This genus has numerous close allies in Australia and the Malay Archipelago. Those here described are *Critomerus*, separated on account of the bidentate anterior femora; *Axionicus*, *Metraniomorpha*, and *Tepperia* on account of the intermediate tibiæ being angular outwardly; and *Pseudotepperia* and *Queenslandica*, on account of the coarsely faceted eyes. I have not described these allied genera in full, but have compared them with the above diagnosis and have described only those parts which are at variance with it.

The genus itself is rather numerously represented in Australia, but is not confined to it. The species now described may be divided into five sections. In the first section the rostrum is curved and longer than in the other species, the shoulders more prominent, and the clothing prettily variegated; it comprises two species (*ocellatus* and *carus*). The second section comprises three very closely allied species (*mucidus*, *multimaculatus* and *variegatus*), all having the elytral suture strongly raised, the clothing but slightly variegated and the rostrum almost perfectly straight. The third section takes in two species (*granulatus* and *semicalvus*), but they are not very closely allied; they agree, however, in having the body less convex, the prothorax more transverse and the rostrum feebly curved. The fourth section includes two species (*brevicollis* and *robiginosus*) showing a decided approach to *Cryptorhynchus*; in them the body is somewhat depressed, the prothorax rather strongly transverse, the rostrum lightly curved and the clothing dense. The fifth section contains three species (*intricatus*, *intricatior* and *albonotatus*), in all of which the intermediate tibiæ are slightly angular at the outer base, the mesosternal receptacle less solid than usual and the ocular fovea very narrow.

- Elytra with a round eye-like spot on each side at base *ocellatus*, Redt.
- Elytra without eye-like spots.
  - Ocular fovea large, transverse and bounded by eyes *semicalvus*, n.sp.
  - Ocular fovea smaller and longitudinal or indistinct.
    - Prothorax distinctly granulate.................... ... *granulatus*, n.sp.

Prothorax not granulate.
  Intermediate tibiæ not angular at outer base.
    Prothorax with very small punctures.
      Elytral scales condensed into more or less large patches.............. .... *variegatus*, n.sp.
      Elytral scales nowhere condensed into large patches.
        Elytral suture suddenly elevated near base.................................... *mucidus*, Pasc.
        Elytral suture less suddenly elevated.... *multimaculatus*, n.sp.
    Prothorax with rather large but more or less concealed punctures.
      Alternate interstices not elevated. .... *carus*, n.sp.
      Alternate interstices elevated.
        Mesosternal receptacle strongly depressed at base .... *robiginosus*, n.sp.
        Mesosternal receptacle not so............ *brevicollis*, n.sp.
  Intermediate tibiæ angular at outer base.
    Elytra nowhere granulate....................... *albonotatus*, n.sp.
    Elytra with granules in places.
      Prothorax without large punctures......... *intricatus*, n.sp.
      Prothorax with large punctures on disc... *intricatior*, n.sp.

PERISSOPS OCELLATUS, Redt.; Mast. Cat. Sp. No. 5567.

Enteles ocellatus, Redt.

♂. Ovate, subopaque. Dark brown. Rather densely clothed with small round scales of a brownish colour varying in places, a moderately distinct pale oblique fascia behind middle sometimes occupying the whole of the apical third, pale scales about median prothoracic line; elytra with elongate (and in places pale) scales scattered about, and with a moderately large, round, dark, velvety eye-like spot on each side at base between shoulders and suture. Under surface and legs with dense ochreous elongate scales; anterior portion of pectoral canal densely clothed, the scales paler there than elsewhere. Basal third of rostrum squamose.

Head with almost concealed punctures; vertex with a slight carina continued on basal portion of rostrum and depressed between and behind eyes. ***Rostrum*** curved, long, rather thin, shining; finely punctate; sides slightly incurved to middle, grooved, the grooves parallel with and just above scrobes and terminating before antennæ. Scape slightly curved and compressed; basal joint of funicle thicker and shorter than 2nd, 2nd the length of 3rd-4th, these equal and equal in length to 5th-7th; club the length of five preceding joints, subsolid, finely pubescent. *Prothorax* conical, transverse; finely punctate; with a very feeble median carina (sometimes entirely absent). *Scutellum* small, rounded, shining. *Elytra* subcordate, almost twice the length of prothorax and wider at base, shoulders thickened; each with eleven rows of small shallow punctures; interstices round in places, scarcely raised; apex slightly emarginate. Apical segment of *abdomen* densely and rather coarsely punctate. *Legs* finely punctate; anterior femora almost edentate, each of the others with a moderately strong tooth; anterior tibia without a small subapical tooth, but the terminal hook large. Length 13½, rostrum 4; width 7 mm.

♀. Differs in being less robust, prothorax less transverse, anterior legs shorter, rostrum thinner and slightly longer, not at all incurved to middle and dilated to apex, antennæ thinner and the scape not extending quite to apex of rostrum.

Hab.—S. Queensland—Northern Coastal Rivers of New South Wales.

The eye-like spots on the elytra render this species one of the most distinct of the Australian weevils; in even greatly abraded specimens they remain intact. The locality of "Sydney" given by Herr Redtenbacher is probably incorrect.

PERISSOPS CARUS, n.sp.

Elliptic, moderately convex, lightly shining. Reddish-brown, antennæ paler. More or less densely clothed with scales varying from white to sooty-brown. Head with sooty scales, a small yellowish spot between eyes, one behind each, and one at base; prothorax with a large discal subtriangular patch of pale fawn and white scales, the white scales in patches; a small disconnected white spot on each side of apex, flanks with dark scales; scutellum glabrous (in three specimens); elytra with white, pale fawn and dark scales in strong contrast at base, and more or less distinctly so posteriorly, elsewhere feebly mottled. Under surface with dense and pale scales; legs more or less distinctly variegated.

Head with dense concealed punctures; ocular fovea indistinct. Rostrum the length of prothorax, lightly curved; sides at basal third coarsely punctate, elsewhere shining and minutely punctate. Scape inserted two-fifths from apex of rostrum and a trifle longer than funicle; 1st joint of the latter as long as 2nd and 3rd combined, 2nd as long as 3rd and 4th combined. *Prothorax* with dense, round, concealed punctures; median carina feebly traceable. *Elytra* wider than prothorax, strongly convex (especially along middle), with series of large punctures becoming much smaller posteriorly; interstices wider than punctures, themselves feebly punctate; suture finely granulate except at extreme base and posteriorly. *Under surface* with dense, partially concealed punctures; metasternal episterna each with a single irregular row. *Femora* with moderately large acute teeth. Length 8¼, rostrum 2½; width 4 mm.

Hab.—Q.: Endeavour River (Mr. G. Masters).

A very pretty and distinct species allied (but not closely so) to *ocellatus*. On the 4th interstice, at the base of each elytron, there is a distinct subquadrate patch of dark scales, but it is not at all eye-like in character.

PERISSOPS MUCIDUS, Pasc.; *l.c.*, No. 5499.

♂. Elliptic-ovate, strongly convex, shining. Dark brown. Clothed with ochreous scales disposed in small patches; prothorax with a median line of scales dilated on basal half, a line of scales on each side; elytral suture without scales, elytra with small round brown scales scattered about, prothorax with similarly coloured but more elongate scales, and which give the disc a scratched appearance. Under surface with dense ochreous elongate scales, on the abdomen forming three lines down the middle, smaller scales elsewhere; anterior portion of pectoral canal with pale elongate scales; legs with shorter and sparser scales than on sterna. Head with ochreous scales disposed in patches, sides of base of rostrum squamose.

Head finely punctate; ocular fovea deep and distinct; a narrow shining carina commencing at fovea and continued almost to antennæ, at its side two feeble irregular ridges slightly curved and terminating before carina. Rostrum long, rather flat, curved at apex; densely punctate and opaque; sides grooved, the groove just above but scarcely parallel with scrobes, terminating at antennæ. Scape straight; two basal joints of funicle elongate, 3rd-6th feebly decreasing, 7th slightly larger than 6th; club the length of four preceding joints. *Prothorax* subconical, transverse, finely punctate; on the flanks, especially towards base, with dense, rather large oblique punctures; constriction marked by rather small deep punctures. *Scutellum* small, longer than wide, smooth, apex pointed. *Elytra* along suture considerably more than thrice the length of prothorax, at base scarcely wider, widest about middle; middle strongly raised and suture almost crested, summit nearer base than apex, posterior declivity fully half total length; each with ten rows of small punctures; interstices rounded, scarcely raised; basal two-thirds of suture rather densely granulate, the granules minute, depressed, shining and placed in transverse series; apex scarcely emarginate. Apical segment of *abdomen* with large, round, shallow punctures. *Legs* finely punctate; femora dentate, the anterior less strongly than the others; anterior tibiæ bisinuate beneath, with a subapical swelling but without a tooth. Length 12½, rostrum 3¼; width 6½ mm.

♀. Differs in being usually larger, legs shorter, elytra with suture much less distinctly raised in the middle and almost obsoletely granulate, rostrum smooth, shining and finely punctate, antennæ thinner, scape just reaching apex of rostrum, and paler.

Hab.—S. Queensland—Northern Coastal Rivers of New South Wales.

The crest on the elytra is more distinct than in the other species here described. The small brown scales on the elytra are invisible to the naked eye, as they so closely resemble the derm on which they rest. The species is exceedingly common on the Richmond River.

PERISSOPS MULTIMACULATUS, n.sp. v. n.var.

♂. Reddish-brown. Median prothoracic line of scales interrupted in middle and not dilated at base. Elytra with suture moderately strongly but not suddenly raised. Other characters as in *mucidus*. Length 11, rostrum 2¾; width 5½ mm.

Hab.—Endeavour River (Macleay Mus.).

Very close to and probably only a (very distinct) variety of *mucidus*. I have but two male specimens under observation, but the species or variety appears to be very common about the Endeavour River. Each of the elytral spots of pale scales seldom covers more than a single puncture, so that they are much more numerous than in either *mucidus* or *variegatus*.

PERISSOPS VARIEGATUS, n.sp.

Elliptic-ovate, strongly convex, subopaque. Dark brown, funicle paler. Clothed with whitish and pale ochreous scales disposed in patches; elytra almost entirely clothed; from base along suture to middle, and thence an oblique irregular line to each side, and several small spots near base apparently nude, but clothed with minute scales almost identical in colour with the derm on which they rest; prothorax with sides rather densely clothed, median line marked at apex with a narrow spot of scales, a larger spot at base and a small spot on each side in front of basal spot. Under surface and legs rather sparsely squamose, the scales small and rounded, except on sterna, where they are moderately elongate and denser; anterior portion of pectoral canal squamose. Head with a patch of scales on summit and behind each eye; rostrum rather sparsely squamose throughout.

Head finely punctate; ocular fovea deep; eyes subcontiguous, a depression between and behind them. Rostrum moderately long, straight, rather wide and flat; irregularly punctate; a shining carina commencing at ocular fovea and continued past antennæ, two irregular elevations on each side between antennæ, base irregularly and shallowly grooved, sides grooved, grooves above but not parallel with scrobes, and terminating at antennæ. Two basal joints of funicle elongate, 1st slightly longer than 2nd, 3rd-7th gradually increasing in width and decreasing in length; club the length of four preceding joints. *Prothorax* subconical, transverse; finely punctate, flanks punctured almost as in *P. mucidus*, but the punctures more open. *Elytra* about thrice the length of prothorax, slightly wider at base, slightly the widest about middle; suture with three distinct slopes (2 mm. at base raised at about 60°, 7 mm. in middle decreasing at about 15°, 5 mm. posterior declivity at about 45°); rather densely granulate except on apical fourth, a few glossy granules on 2nd-5th interstices near base; each elytron with ten almost impunctate striæ, interstices rounded, scarcely raised; apex feebly emarginate. Apical segment of *abdomen* with a few large punctures. *Legs* finely punctate; femora dentate, the intermediate more strongly than the others; anterior tibiæ bisinuate beneath, each with a small subapical tooth in addition to the terminal hook. Length 13½, rostrum 3⅓; width 6½ mm.

♀. Differs in being less robust, rostrum shining, finely punctate, much narrower and not carinate, antennæ thinner, scape not reaching apex of rostrum, legs shorter, and elytral suture less raised.

Hab.—N.Q.: Endeavour River (Mr. G. Masters).

Approaches *P. mucidus*, but is abundantly distinct from that species. The outline of the male, when viewed from the side, resembles a reaper's sickle, as it does also in *mucidus*. There are a few granules about apex of elytra, but they are usually concealed by scales.

PERISSOPS GRANULATUS, n.sp.

Elliptic, opaque. Black, antennæ and apical joints of tarsi of a rather dingy red. Rather sparsely clothed with dingy whitish scales, denser on apical third of elytra and sides of prothorax than elsewhere. Under surface and legs rather sparsely squamose, the scales varying in colour from dingy white to brown; apical segment of abdomen densely squamose; anterior portion of pectoral canal squamose. Head with several small patches of ochreous scales.

Head densely punctate, slightly depressed between eyes; ocular fovea not traceable. Rostrum shorter than prothorax, slightly curved, moderately wide; densely and coarsely punctate, punctures smaller towards apex; lateral grooves scarcely traceable. Scape inserted slightly nearer apex than base of rostrum, and shorter than funicle; two basal joints of funicle elongate; club rather short. *Prothorax* transverse, scarcely conical, sides subparallel near base, incurved to apex; densely covered with small shining granules, except at apex which is punctate. *Scutellum* small, somewhat rounded, depressed in the middle. *Elytra* about thrice the length of prothorax, slightly wider at base, feebly decreasing to near apex; with numerous small shining granules on basal half, each of which overhangs a puncture; each elytron with about ten rows of rather large punctures, larger towards base than towards apex; interstices slightly raised and irregular. *Under surface* with rather dense, strong punctures. *Legs* densely punctate; femora strongly dentate, and each with a granule in emargination; tibiæ feebly ribbed. Length 10, rostrum 2; width 4½ mm.

Hab.—Q.: Gayndah (Mr. G. Masters), Cairns (Macleay Mus.).

Each of the femora is supplied with a small granule in its emargination, but on the four posterior they are very small. The prothoracic granules are obliquely truncate in front, and each has a small median puncture.

PERISSOPS SEMICALVUS, n.sp.

Subcylindrical and lightly shining. Reddish-brown, antennæ (club excepted) paler. Densely clothed with pale ochreous scales with white ones rather sparsely distributed amongst them, a small angular spot of sooty scales on 2nd interstice not far from apex. Under surface with scales varying from almost white on the sterna to ochreous and sooty on the abdomen. Head glabrous except for a patch behind each eye and a longitudinal patch at base; sides of rostrum squamose.

Head very minutely punctate, with a feeble longitudinal impression at base; ocular fovea very large, bounded on each side by the eye itself. Rostrum wide, slightly shorter than prothorax, moderately curved, sides incurved to middle; in ♂ with distinct punctures throughout but coarse only at sides of basal third, in ♀ shining and finely punctate except at sides of base. Scape inserted two-fifths from apex of rostrum and the length of funicle; 1st joint of funicle stouter but very little longer than 2nd, 2nd the length of 3rd and 4th combined. *Prothorax* rather strongly transverse; with dense partially concealed punctures. *Elytra* subcylindrical, very little wider than prothorax; with series of large punctures becoming much smaller posteriorly; interstices wider than punctures and separately convex, the 3rd, 4th and 5th subtuberculate and granulate at base. *Under surface* with dense partially concealed punctures. *Femora* with rather large acute teeth. Length 7½, rostrum 1½; width 3 mm.

Hab.—Q.: Endeavour River (Mr. G. Masters).

The ocular fovea is larger than in any other species of the subfamily with which I am acquainted. To the naked eye the basal half of the elytra appears to be clothed with dark scales in patches, but this is almost entirely due to the scales there being much sparser than elsewhere; on the prothorax three spots (from the same cause) may be seen at the base.

PERISSOPS ALBONOTATUS, n.sp.

♂ (?) Elongate-ovate, strongly convex, polished. Black, antennæ almost black. Clothed with very distinct but small patches of white scales, the interspaces very feebly and indistinctly clothed with small white scales.

Head with sparse, indistinct but not concealed punctures; ocular fovea very narrow. Rostrum stout, the length of prothorax, feebly curved, sides incurved to middle; rather distinctly punctate except between antennæ. Scape inserted two-fifths from apex of rostrum and shorter than funicle, two basal joints of funicle rather long, 1st as long as 2nd and 3rd combined, 2nd as long as 3rd and 4th combined; club (for the genus) rather short. *Pro-*

thorax feebly transverse; with dense, minute punctures and with much larger (but still small) punctures scattered about. *Elytra* widest at about middle, at base scarcely wider than prothorax; with series of rather large punctures becoming much smaller posteriorly; alternate interstices feebly and irregularly but distinctly raised. *Under surface* with rather sparse minute punctures; metasternal episterna impunctate in middle. *Femora* rather less stout than usual and obtusely dentate; intermediate tibiæ very feebly angular at outer base. Length 8½, rostrum 2⅓; width 4 mm.

Hab.—N.S.W.: Richmond River (Mr. W. W. Froggatt).

The majority of the punctures are not concealed, even on the prothorax. On the prothorax there are about four patches of white scales on each side and a very distinct median stripe on apical half; on each elytron there are about fifteen small spots of irregular size and more numerous posteriorly than elsewhere; the sterna and legs are rather densely clothed; on the head there is a stripe at the base.

PERISSOPS INTRICATUS, n.sp.

Elongate-ovate, subcylindrical, moderately shining. Brownish-black. Clothed with scales of a sooty-brown and almost pure white in strong contrast, the white scales forming more or less irregular patterns. Under surface and legs with white scales, with sooty scales in obscure patches. Head and base of rostrum with white scales, the former with pale fawn-coloured scales in middle but with a longitudinal white stripe at base.

Head with small dense and partially concealed punctures; ocular fovea very narrow. Rostrum moderately wide, the length of prothorax, feebly curved; distinctly punctate except between antennæ. Scape inserted not much closer to apex than base of rostrum and shorter than funicle; 1st joint of funicle the length of 2nd and 3rd combined, 2nd slightly shorter than 3rd; club oblong-ovate. *Prothorax* lightly transverse, punctures as in the preceding except that they are concealed by clothing. *Elytra* widest at about middle, at base no wider than prothorax; with series of large punctures becoming much smaller posteriorly; interstices wider than punctures, separately convex, the 3rd rather strongly raised and granulate at base, suture feebly transversely granulate. *Under surface* minutely punctate. *Femora* feebly dentate; intermediate tibiæ distinctly angular at the outer base. Length 9, rostrum 2½; width 4 mm.

Hab.—Q.: Brisbane (type in Mr. A. Simson's Coll.).

The white markings on the prothorax are all connected and consist of a stripe on each side and which are divided at base and again at apex, joined together across apical third and with a stripe on apical half crossing it; on each of the elytra there is a semicircle extending from the base to basal fourth, a zigzag oblique stripe extending from near base to suture at apical third, where from the 3rd and 4th interstices it sends out an irregular stripe that extends quite to the apex with a short inner projection.

PERISSOPS INTRICATIOR, n.sp.

Elliptic, subcylindrical and subopaque. Blackish-brown, antennæ scarcely paler. Clothed with white scales forming patterns, the interspaces with sparse, minute and darker scales. Under surface, legs, head and sides of base of rostrum with white scales.

Head and antennæ as in the preceding. Rostrum considerably shorter and stouter but with similar punctures. *Prothorax* rather strongly transverse; densely and minutely punctate, and with large, round, dense, clearly cut punctures. *Elytra* at extreme base no wider than prothorax, but wider a short distance below, thence parallel-sided to near apex; with series of large punctures, on basal half wider than interstices but becoming very indistinct posteriorly; interstices separately convex, the alternate ones very feebly raised, the suture and four interstices on each side on basal half with feeble granules, 3rd and 4th subtuberculate at base. *Under surface* with small but very distinct punctures. *Femora* acutely dentate; intermediate tibiæ distinctly angular at the outer base. Length 6½, rostrum 1⅜; width 3 mm.

Hab.—Q.: Barron River (type in Macleay Mus.).

Close to the preceding species, but the body more compact, the punctures much stronger (especially on prothorax) and the rostrum shorter. The pattern of the white scales is much as in *intricatus*, but is less sharply defined owing to their looseness and the sparsity of darker ones. On the elytra the markings are as described in that species except that the zigzag stripe commences at the base itself; on the prothorax the markings are the same except that in addition the median line is continuous and that there is an irregular transverse line from coxa to coxa.

PERISSOPS BREVICOLLIS, n.sp.

Oblong-elliptic, subdepressed, opaque. Brownish-black, antennæ of a dingy red. Rather densely clothed with ochreous scales, with small sooty spots and single white scales scattered about. Under surface and legs with dense and rather pale scales.

Head with dense partially concealed punctures; ocular fovea feeble. Rostrum the length of prothorax, moderately curved and comparatively thin; in ♂ with distinct punctures (except between antennæ), becoming coarse on basal third, in ♀ distinctly punctate only at basal third. Scape inserted two-fifths from apex of rostrum and slightly shorter than funicle; 1st joint of funicle as long as 2nd and 3rd combined, 2nd as long as 3rd and 4th combined. *Prothorax* strongly transverse, sides strongly rounded; with dense, round, moderately large, partially concealed punctures. *Elytra* slightly wider than prothorax, shoulders produced, sides parallel to near apex; with series of large punctures becoming smaller posteriorly; interstices densely punctate, the alternate ones raised, 3rd more strongly raised at base than the others and with small granules. *Under surface* with dense and not very small punctures. Mesosternal receptacle semicircular and not suddenly depressed at base. *Femora* with large and acute teeth. Length 6⅓, rostrum 1½; width 3 mm.

Hab.—Q.: Endeavour River (Mr. G. Masters), Cairns (Macleay Mus.).

A rather aberrant species and less convex than any of the others here described. On one of the (6) specimens under examination there is a feeble oblique whitish fascia from the shoulder to the basal third, but not quite reaching the suture.

PERISSOPS ROBIGINOSUS, n.sp.

Elliptic, opaque. Black, antennæ of a rather dingy red. Densely clothed with ochreous scales, amongst which white scales are singly but rather thickly interspersed, each elytron with a large triangular patch of dark scales, scutellum glabrous. Under surface and legs with whitish scales.

Head with dense concealed punctures; ocular fovea indistinct. Rostrum the length of prothorax, lightly curved, wide, sides incurved to middle; in ♂ with rather coarse punctures (except between antennæ), becoming decidedly coarse on basal third; in ♀ the rostrum is longer and thinner, and the punctures, though moderately distinct in front, are coarse only on the basal fourth. Scape in ♂ inserted slightly closer to apex than base of rostrum (in ♀ *vice versa*) and shorter than funicle, the latter as in the preceding species, except that it is a little stouter. *Prothorax* moderately transverse; with dense, moderately large and more or less concealed punctures; with a scarcely traceable median carina. *Elytra* scarcely wider than prothorax, shoulders very feebly rounded, parallel-sided to near apex; with series of large punctures becoming smaller posteriorly; interstices wider than punctures, the alternate ones feebly raised, and all with minute shining granules, which become very indistinct posteriorly. *Under surface* with dense and not very small punctures. Mesosternal receptacle lightly transverse, base almost flat, suddenly and strongly elevated in front. *Femora* with rather large acute teeth. Length 9, rostrum 2¼; width 4; variation in length 7-9½ mm.

Hab.—Q.: Cape York, Somerset (Macleay Mus.), Endeavour River (Mr. C. French), Mount Dryander (Mr. A. Simson).

Allied to but very distinct from the preceding species. On some of the (6) specimens under examination there are a few small sooty patches on the disc of both prothorax and elytra; on the former there are sometimes four feeble whitish spots. The large dark patches on the elytra form isosceles triangles, of which the widest side extends from each shoulder to the 3rd interstice beyond the middle; on perfect specimens the triangles are sharply defined, but when rubbed, these are less distinct.

Genus AXIONICUS, Pascoe.

Journ. Linn. Soc., Zool., x. 1869, p. 455.

Eyes large, finely faceted, rather widely separated. Rostrum rather stout and almost straight. *Antennæ* rather stout. *Legs* rather long; femora feebly grooved and dentate, posterior not extending to apex of abdomen; tibiæ flat and thin, almost straight, external edge of the intermediate angular. Other characters as in *Perissops*.

This genus is very close indeed to *Perissops*, but as its type is a well marked and well known species it was not thought advisable to propose its degradation; more especially when it is considered that some of the species now placed in *Perissops* may not remain there.

AXIONICUS INSIGNIS, Pasc.; *l.c.* No. 5501.

♂. Elliptic, strongly convex, as deep as wide. Black or brownish-black. Densely and irregularly clothed with short or subelongate scales, varying from snowy-white to velvety-black.

Head with dense but shallow and partially concealed punctures. Rostrum almost the length of prothorax, almost parallel-sided; coarsely and irregularly punctate. First joint of funicle longer than 2nd. *Prothorax* subconical, no wider than long; with irregular and rather coarse punctures; with several longitudinal waved and obtuse ridges, and a very distinct median carina. *Elytra* strongly convex throughout, not much more than twice the length and outline continuous with that of prothorax; punctures not very large; alternate interstices very distinctly raised and usually shining, the 3rd subtuberculate near base; a subtriangular space from the shoulders to the suture beyond the middle with distinct granules, each of which is hollow and bears a seta on its posterior face. *Under surface* with dense, partially concealed punctures. Anterior *legs* long and thin, their femora very minutely dentate, and tibiæ almost perfectly straight; four posterior femora shorter, stouter and more distinctly dentate; intermediate tibiæ lightly curved, and with an angular projection near the outer base, so that the basal portion appears to be quadrate. Length 16, rostrum 4½; width 7; variation in length 11-16 mm.

♀. Differs in having the femora with equal teeth, and the anterior and posterior of equal length, the rostrum thinner, suddenly narrowed from near base, the wider portion only squamose, elsewhere being shining and comparatively finely and sparsely punctate.

Hab.—"Queensland" (Pascoe), Rockhampton (Macleay Mus.) —N.S.W.: Wellington (Mr. W. W. Froggatt), Tamworth (Lea).

One of the most distinct species of the subfamily. The white scales form a distinct patch at the apex of prothorax, a very distinct postmedian oblique fascia on the elytra, almost entirely clothe the metasternum, are distributed in small spots and stripes on the abdomen, and are prettily variegated with dark brown on the legs.

METRANIOMORPHA, n.g.

Eyes very large, rather finely faceted, subapproximate. *Rostrum* moderately short and stout, feebly curved. *Antennæ* rather stout; club oblong-ovate, sutures straight. *Elytra* oblong-cordate, wider than prothorax at base. *Pectoral canal* terminated between four anterior coxæ. *Mesosternal receptacle* rather strongly raised, sides incurved to base, emargination semicircular; cavernous. *Legs* rather short, femora stout, dentate, distinctly grooved, posterior not extending to apex of abdomen; tibiæ scarcely compressed, external edge angular. Other characters as in *Perissops.*

METRANIOMORPHA ENTIMA, n.sp.

Dark brownish-black, antennæ dull reddish-brown. Moderately densely clothed with small but moderately long sooty adpressed scales, under surface and legs with longer and pale scales. Head with two very distinct eye-like spots of sooty-black scales surrounded by white scales, the white scales conjoined between the two spots; each elytron at apex with a round spot of velvety-black scales surrounded by a snowy-white ring; white scales margining scutellum.

Head with punctures and ocular fovea concealed; eyes almost touching. Rostrum slightly shorter than prothorax and rather wide, wider at apex than elsewhere; coarsely punctate, but punctures more or less concealed behind antennæ; with a feeble median ridge. Scape shorter than funicle, inserted two-fifths from apex of rostrum; two basal joints of funicle stout but moderately long, the others transverse. *Prothorax* moderately transverse, sides strongly rounded, base strongly bisinuate; disc feebly, the sides rather strongly, punctate. *Scutellum* round, level with but separated from elytra by a circular impression. *Elytra* considerably (but not suddenly) wider than prothorax, and fully thrice as long, sides gently and continuously rounded; with series of small distant punctures; interstices much wider than punctures, and not separately rounded. *Under surface* rather densely punctate; 3rd and 4th abdominal segments drawn backwards at sides. *Femora* stout, rather acutely dentate, posterior scarcely extending to apical segment; all the tibiæ angular at the outer base, the posterior near the apex as well. Length 9½, rostrum 2; width 5¼ mm.

Hab.—N.S.W.: Ballina (Mr. W. W. Froggatt).

The outline of this species is much the same as that of *Metrania palliata* as figured by Mr. Pascoe.* The eye-like spots are very distinct on both head and elytra; the white scales about the scutellum are less distinct; on the prothorax there are several feeble clusters of pale scales. The sooty scales on the unique specimen under examination have a greasy appearance, despite the fact that it has been boiled as well as soaked for some considerable time in chloroform.

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* Journ. Linn. Soc., Zool., xi., pl. xiii., fig. 11, 1872.

TEPPERIA, n.g.

Eyes moderately large, finely faceted, rather widely separated. *Rostrum* short, wide and feebly curved. *Antennæ* stout; scape inserted nearer apex than base of rostrum and longer than funicle; 1st joint of funicle stout, the others strongly transverse; club stout, almost the length of funicle, sutures oblique. *Elytra* cordate, wider than prothorax and each separately rounded at base. *Mesosternal receptacle* feebly raised, semicircular, cavernous. *Legs* short; tibiæ rather flat, feebly curved, external edge angular. Other characters as in *Perissops*.

From nearly all the close allies of *Perissops* this genus may be distinguished by the very short funicle and by each elytron being separately rounded at the base; it is very close to *Axionicus*, but the two characters mentioned are sufficiently distinctive. I have dedicated the genus to Mr. J. G. Otto Tepper, of the South Australian Museum, and the first (so far as I am aware) to attempt to popularise the study of Australian insects.

Length 9 mm, or less.............................. .... *sterculiæ.*
Length 11 mm. or more... .. .. *major.*

TEPPERIA STERCULIÆ, n.sp.

Dark reddish-brown. Very densely clothed with scales varying from a pale to dark chocolate-brown and interspersed (rather thickly at sides of prothorax) with white scales; elytra with a very distinct whitish fascia at summit of posterior declivity, extending between the 5th interstices, the margins more or less indented and bounded anteriorly and posteriorly by darker scales. Under surface and legs with dense whitish scales, becoming darker (but picked out with white scales) on three apical segments, the tibiæ and apex of femora. Head and rostrum with paler scales than on prothorax, and with white scales (thick on apex of rostrum) rather thinly scattered about.

Head with dense concealed punctures; towards base with an impressed (but concealed) median line. Rostrum shorter than prothorax, very feebly curved, sides incurved to middle, scarcely twice as long as the greatest width; with dense concealed punctures throughout and with a feebly traceable median carina. *Prothorax* transverse, subconical, base bisinuate; with dense minute punctures and scattered larger ones, all of which are concealed. *Scutellum* subquadrate. *Elytra* not much wider than prothorax and scarcely twice and one-half as long, shoulders rounded, sides feebly decreasing (with a rounded outline) to near apex; with series of large, round, deep, more or less concealed punctures, becoming smaller posteriorly; alternate interstices distinctly but rather feebly raised. *Under surface* with dense, minute and concealed punctures and with larger partially exposed ones. Suture between 1st and 2nd abdominal segments lightly curved in middle. *Femora* stout, shallowly grooved and rather feebly dentate, posterior scarcely extending to penultimate segments; all the tibiæ angular outwardly near base. Length 9, rostrum 2; width 5; variation in length 7½-9 mm.

Hab.—N.S.W.: Yass (Mr. W. W. Froggatt), Clarence River (Macleay Mus.), Tamworth (Lea; on the "Kurrajong" *Sterculia* sp.).

The elytral fascia is always distinct though much less so on some specimens than on others.

TEPPERIA MAJOR, n.sp. v. n.var.

Dark reddish-brown. Very densely clothed with rusty-brown scales (paler on under surface than elsewhere), amongst which white scales are rather thinly scattered, prothorax with an obscure darker patch at base; elytra at summit of posterior declivity with a fasciate patch (wider along suture than at sides) of whitish scales extending between the 5th interstices. Length 11½, rostrum 3; width 6⅔; variation in length 11-12 mm.

Hab.—N.S.W.: Richmond River.

In general appearance very close to the preceding species, but the rostrum longer and more noticeably curved, the elytra proportionately wider, the clothing less variegated and rustier, with the individual scales longer; the scales have also a decided tendency to form into small fascicles (especially those composing the fascia), whilst in the preceding species this is much less the case. I have also never seen a specimen of *major* less than 11 mm., nor of *sterculiæ* more than 9 mm. in length.

PSEUDOTEPPERIA, n.g.

Eyes not very large, ovate, rather coarsely faceted. *Rostrum* rather short and stout, feebly curved. *Antennæ* moderately stout; scape inserted nearer apex than base of rostrum and the length of funicle; two basal joints of the latter moderately long, the others strongly transverse; club rather large, almost the length of funicle, sutures oblique. *Elytra* elongate-cordate, wider than prothorax and each separately rounded at base. Other characters as in *Perissops.*

In its elytra separately rounded at the base and short funicle this genus resembles *Tepperia,* but the tibiæ are different and the facets of the eyes larger.

PSEUDOTEPPERIA COMPTA, n.sp.

Black, antennæ and tarsi reddish-brown. Moderately densely clothed with ochreous-brown scales, becoming chocolate-brown in places, prothorax with a few feeble spots of pale scales; each elytron with two large patches of cream-coloured scales and two velvety black spots.

Head with dense concealed punctures. Rostrum shorter than prothorax, sides slightly irregular; densely and strongly punctate throughout, but the punctures concealed behind antennæ. *Prothorax* lightly transverse, sides strongly rounded, base very decidedly bisinuate and more than twice the width of apex; densely punctate throughout, the punctures rather large but more or less concealed, on the side the interstices between the punctures frequently showing as granules; with a feeble but almost continuous median carina. *Scutellum* small and shining. *Elytra* not much and not suddenly wider than prothorax, and about twice and one-half as long; with series of apparently large but concealed punctures; interstices rather narrow and with irregular series of small shining granules. *Under surface* with dense but more or less concealed punctures. *Legs* rather short and densely punctate; femora stout, distinctly but not very strongly dentate, posterior scarcely extending to apical segment; tibiæ feebly compressed and bisinuate beneath, in addition to the (strong) terminal hook each with a subapical tooth. Length 8, rostrum 2; width 4 mm.

Hab.—N.W. Australia (type in Macleay Mus.).

The pale patches of scales on the elytra are near the base and on the posterior declivity; the basal patch extends from the 3rd interstice to the margin, its anterior inner angle being marked with a dark and perfectly circular velvety spot; the posterior patch is irregularly semicircular in outline and commences on the 2nd interstice; its inner face at the middle is marked with an angular dark spot similar in character to the basal one.

CRITOMERUS, n.g.

Eyes large, rather finely faceted, subcontiguous. *Rostrum* moderately long and rather thin but not rounded, lightly curved. *Club* ovate, sutures straight. *Pectoral canal* terminated between four anterior coxæ. *Abdomen* with perfectly straight sutures, 1st segment slightly longer than the two following combined, intercoxal process narrow, 2nd the length of 5th and very slightly longer than 3rd or 4th. Anterior *femora* bidentate. Other characters as in *Perissops.*

Closely allied to *Perissops*, but the anterior femora bidentate. The species described below appears to be a common one in certain parts of Queensland. This genus is a highly interesting one on account of the bidentate anterior femora.

CRITOMERUS EMBLEMATICUS, n.sp.

Brownish-black, antennæ of a dingy red. Densely clothed with scales varying from a dark straw-colour to ochreous; prothorax with small chocolate-brown scales except on sides, a few spots scattered about, and a basal median patch that is suddenly narrowed in front at its middle and has a slight projection on each side before the narrower part; each elytron with a triangular patch of chocolate-brown scales extending from the side to the 3rd interstice beyond the middle, the side beyond the triangle with a small dark spot, each side at base with two small dark spots. Each of the femora and tibiæ with an obscure spot of dark scales. Head behind and between eyes and sides at base of rostrum feebly clothed.

Head with small, dense, not concealed punctures. Rostrum the length of prothorax, moderately wide, sides lightly incurved to middle; basal half coarsely punctate, apical half shining and rather finely punctate. Scape inserted one-third from apex of rostrum; two basal joints of funicle subequal in length, 4th-7th transverse. *Prothorax* transverse, subconical, base rather strongly bisinuate and more than twice the width of apex; with small, dense, more or less concealed punctures. *Scutellum* shining and oblong-ovate. *Elytra* scarcely more than twice the length of prothorax, the outlines continuous; with series of small concealed punctures, interstices not separately raised and not at all distinct, with minute shining granules more numerous on and about suture than elsewhere. *Under surface* with dense more or less concealed punctures. *Femora* stout, posterior not extending to apex of abdomen, anterior strongly bidentate, the apical tooth more acute than the basal one; intermediate feebly, the posterior still more feebly unidentate; tibiæ lightly curved. Length 8, rostrum 2¼; width 4⅓ mm.

Hab.—Queensland (Mr. C. French), Cairns (Mr. G. Masters), Endeavour River (Macleay Mus.).

A strongly marked species. The pale basal patch on the prothorax is not unlike the crest of the Prince of Wales.

QUEENSLANDICA, n.g.

Eyes moderately large, coarsely faceted. *Rostrum* not very long, moderately wide, almost straight. *Antennæ* rather stout; club rather large and ovate, sutures feebly curved. *Prothorax* strongly transverse. *Pectoral canal* terminated between four anterior coxæ. *Mesosternal receptacle* feebly raised, strongly transverse, emargination widely transverse; cavernous. *Legs* rather short; femora edentate, distinctly grooved. Other characters as in *Perissops*.

The eyes are more coarsely faceted than in any of the close allies of *Perissops*, the prothorax is more transverse and the femora are edentate, so that the genus is a rather distinct one.

Elytra with a circular patch of dark scales posteriorly............. *posticalis*.
Elytra without dark scales posteriorly.................................. *mundus*.

QUEENSLANDICA POSTICALIS, n.sp.

Reddish-brown, antennæ paler. Elytra with large, soft, dingy whitish scales, a large and almost circular patch of chocolate-brown scales on posterior declivity. Under surface with large, soft, round, dingy white scales; legs densely squamose. Head and base of rostrum with dingy scales.

Head with dense concealed punctures. Rostrum the length of prothorax and rather wide, sides feebly decreasing in width to antennæ, thence parallel to apex; basal third strongly punctate, elsewhere shining and finely but distinctly punctate. Scape inserted two-fifths from apex of rostrum and the length of funicle; two basal joints of the latter moderately long and subequal, the others transverse. *Prothorax* bisinuate at base; with dense, round, not very large punctures becoming minute at apex. *Elytra* scarcely wider than prothorax and twice and one-half as long; with series of moderately large almost entirely concealed punctures; interstices regular and feebly separately convex. *Under surface* with moderately dense punctures, each of which is traceable although covered by a scale. Posterior *femora* terminated considerably before apex of abdomen; tibiæ compressed and lightly curved. Length 5¼, rostrum 1⅛; width 2½ mm.

Hab.—Lizard Island (Mr. G. Masters).

As this species is very distinct, I have described it, although on the unique specimen under examination the prothoracic scales are almost entirely abraded; they appear, however, to be much the same as on the elytra.

QUEENSLANDICA MUNDA, n.sp.

Blackish-brown, antennæ dull red. Densely clothed with soft creamy-white scales, darker at base of prothorax and surrounding (except at base) a large median space (where the scales are pale) on the elytra; prothoracic scales much larger than those of elytra and formed into six feeble fascicles, four across middle and two at apex. Under surface with dull white scales becoming darker from middle of 2nd abdominal segment; legs with dark scales picked out with white, except on the lower parts of femora where they are almost entirely white. Head with dense fawn-coloured scales becoming white at base of rostrum.

Head with dense concealed punctures. Rostrum the length of prothorax, sides feebly decreasing in width to near antennæ, thence parallel to apex; in ♂ basal half coarsely punctate, apical half subopaque and moderately strongly punctate; in ♀ only the basal third is strongly punctate, elsewhere shining and finely punctate. *Prothorax*, *elytra* and *legs* as in the preceding. *Under surface* with dense and almost entirely concealed punctures. Length 5, rostrum 1⅙; width 2¼; variation in length 4-5 mm.

Hab.—Q.: Cape York (Macleay Mus.).

The clothing is of a peculiarly soft nature. The prothoracic scales (except those composing the fascicles and a few that are feebly concave) are perfectly flat.

Genus PROTOPALUS, Schönherr.

Gen. Spec. Curc. iv. Pt. 1, p. 44, Genus No. 303; Waterhouse, Trans. Ent. Soc. n. ser. ii. p. 191, Proc. p. 102; Lacordaire, Gen. Col. vii. p. 132.

Head moderately large, not concealed by prothorax; ocular fovea variable. *Eyes* large and finely faceted, produced below. *Rostrum* stout or moderately stout, slightly curved, the length of or considerably longer than prothorax. *Antennæ* variable; slender, inserted closer to apex of rostrum than base; club small, joints oblique. *Prothorax* subconical, apex feebly produced and rounded, base bisinuate; constriction deep; ocular lobes produced, moderately acute and almost right-angled; carinate along median line. *Scutellum* distinct, rounded, transverse or longitudinal. *Elytra* much wider than prothorax, shoulders prominent, sides decreasing in width from base; suture strongly raised. *Pectoral canal* moderately deep and wide, terminated between the intermediate or the four anterior coxæ. *Mesosternal receptacle* variable. *Metasternum* shorter than basal segment of abdomen; episterna moderately large. *Abdomen* large, sutures distinct; 1st segment about twice the length of 2nd; intercoxal process narrow and rounded; 3rd and 4th large, their combined length greater than that of the 2nd or 5th. *Legs* long; femora ridged beneath, the ridge of each terminating in a feeble tooth; feebly grooved; posterior passing elytra or not; tibiæ compressed, thin, in addition to terminal hook with an almost obsolete subapical tooth; tarsi shorter than tibiæ, 3rd joint wide, deeply bilobed, claw-joint elongate, setose; claws stout. Elliptic (except for shoulders), strongly convex, granulate, winged.

One of the most remarkable genera of the Australian *Cryptorhynchides*, and rivalling many of the *Brenthidæ* in its sexual variations. Its most extraordinary feature is the mesosternal receptacle: in *Schönherri* it is open, in *tectus* it is of the usual cavernous form, in *dromedarius* it is very slightly, and in *carinatus* moderately cavernous. The apex of the rostrum in the majority of the species rests in the mesosternal receptacle, but in *Schönherri* it extends beyond it to the abdomen. Four species occur in the tropical scrubs of Queensland and New South Wales, and a fifth* is described from New Guinea. Nearly every species of all the genera (both Australian and foreign) allied to *Protopalus* has a small spot of whitish scales on each side of the elytra towards the apex; in most of the genera also the antennæ are more or less abnormal. Leaving out of consideration characters subject to sexual variation, the Australian species may be thus tabulated :—

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* *P. alboguttatus*, Chev., Pet. Nouv. ii. 1877, p. 189.

Mesosternal receptacle open.................................... *Schönherri*, **Waterh.**
Mesosternal receptacle cavernous.
  First joint of funicle shorter than 2nd.
    Elytral interstices granulate............................ *cristatus*, **Pasc.**
    Only the sutural interstices granulate...... .. .. *dromedarius*, **Boisd.**
  First joint of funicle longer than 2nd......... .... *tectus*, **n.sp.**

PROTOPALUS SCHOENHERRI, Waterh.

Trans. Ent. Soc. n. ser. ii. p. 192 and Proc. p. 102; Mast. Cat. Sp. No. 5575: *P. insignicornis*, Lea, Proc. Linn. Soc. N.S. Wales, 1893, p. 630.

At the time I described this remarkable insect I had only seen the description as given on p. 192 of the Transactions, and was unaware of the note (not mentioned in the Catalogue) in the Proceedings mentioning the lengths of the funicular joints. Mr. Waterhouse, moreover, had only seen the female, and his description of course would not apply to the male. In this species the mesosternal receptacle is decidedly open.

P. SCHOENHERRI, var. ANTENNARIUS, var.nov.

The male as described by me appears to be the normal form, as I have since seen four others agreeing in the remarkable rostrum and antennæ; but I have under examination a small male which I cannot but regard as conspecific, although it differs to a truly remarkable extent in the rostrum, antennæ and legs. The ocular fovea is very small and round. The rostrum is much shorter, much less dilated at apex and near base, and the scrobes are comparatively deep throughout. The scape is the exact length of the rostrum and just passes the eye, the apex when at rest lying in a very shallow impression before the forehead; the 2nd joint of the funicle is almost twice the length of the 1st and at its apex is not much thicker, the swollen portion being decidedly shorter than the 3rd joint; the club is comparatively shorter and stouter. In my type ♂ the anterior femora project for more than half their length in front of the prothorax; in the variety they project only for about one-third, and the other legs are even shorter than in ♀. Its dimensions are :—Length from eyes to apex of elytra 13⅓ (18*); rostrum 6½ (10), scape 5½ (15), first joint of funicle 1½ (5½), second 2½ (6½); anterior femora 6 (9½), posterior 5½ (7⅓). Width across shoulders 6¼ (8); muzzle 1⅓ (2). Depth beneath hump 7 (9) mm.

PROTOPALUS DROMEDARIUS, Boisd.; *l.c.*, No. 5574.

P. Stephensi, Bohem., *l.c.*

♂. Black, elevated portions feebly shining; antennæ piceous-brown, parts of the mouth (mandibles excepted) pale red. Moderately clothed with sooty-brown, ochreous and pale yellow scales; each elytral puncture with one or more scales. Prothorax with three feeble basal stripes of pale scales. Sutural crest of elytra with setæ, short and brown at base, becoming longer and almost black near but not at apex, and with several small tufts of pale scales. Under surface rather more densely clothed than upper, the scales varying from almost white to dark ochreous-brown; abdomen with feeble lines of pale scales; pectoral canal almost glabrous. Head, rostrum and legs rather sparsely squamose. Funicle with long hair, moderately dense inwardly, shorter and sparser outwardly.

Head sparsely and feebly punctate; a feeble ridge behind the (shallow) ocular fovea. Rostrum longer than prothorax, slightly decreasing in width to near antennæ, beyond antennæ flattened, a feeble ridge from ocular fovea to beyond middle, a shorter ridge on each side distinctly elevated near eyes; four grooves opening out between eyes, the two lateral continued almost to antennæ; not strongly but moderately densely punctate, especially at apex, very irregularly towards base; beneath with three irregularly granulate ridges, the inner one rather feeble and punctate at apex. Scape almost the length of funicle and club combined, inserted at about one-fifth from apex of rostrum, and resting in a shallow scrobe; all joints of the funicle longer than wide, the 1st slightly shorter than 2nd and slightly longer than 3rd, 5th-7th subequal in length. *Prothorax* with a strongly elevatod median carina in front, stoutest in middle, and from there feebly continued to base; each side of it in front not granulate, but elsewhere with large granules, each of which is supplied with a sooty seta. *Scutellum* round. *Elytra* about once and one-half the width of prothorax, shoulders produced laterally and angular; sides decreasing to apex, apex widely rounded; suture strongly raised from near base to about one-third from apex, the ridge granulate and abrupt at both its base and apex, a distinct and moderately large subconical tubercle* on third interstice near base; seriate-punctate, the punctures large but rather shallow†; interstices narrow, those near the suture feebly granulate, the 5th and 6th on the disc and shining from near base, the 7th-11th on the sides and highly polished, the 7th and 8th uniting to form the humeral projection. the 9th and 10th curved upwards at base; posterior declivity feebly striate and very feebly punctate. *Mesosternal receptacle* U-shaped, walls thin, open except at extreme base.‡ *Legs* long; posterior femora just extending to apex of elytra. Length 20, rostrum 8; width 10; depth 9½ mm.

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* The dimensions given in brackets are those of the ♂ specimen described by me as *insignicornis*.

Hab.—S. Queensland—N.S.W.: Tweed and Richmond Rivers.

In this species the pectoral canal terminates distinctly beyond the middle of the intermediate coxæ; in the two following it terminates before them.

Mr. Waterhouse remarks:—"I have an insect which agrees with Schönherr's description of *Protopalus Stephensii* so perfectly in all respects, excepting that the rostrum is not crenulated beneath, and the anterior legs are but a trifle longer than the others, that I strongly suspect their differences merely indicate a distinction of sex."§ I do not think it probable that Mr. Waterhouse had the sexes of *Stephensii (dromedarius)* under examination, as in all the genera of the *Mecistostylides* that I have seen the sexual differences of the rostrum and antennæ are very pronounced and unmistakable. M. Lacordaire gave his generic diagnosis from a male which he presumed to be that of *Stephensi*, but in this he was certainly mistaken, the diagnosis being drawn up from the male of *Schönherri*. I have three specimens which agree so perfectly with Boheman's specific description of *Stephensi* and Schönherr's diagnosis of *Protopalus* that it is impossible that I can be mistaken, and dissection proves them to be males; I have also received notes and sketches of the type of *dromedarius* (see these Proceedings, 1900, p. 538, pl. xxx., figs. 1-2).

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* Varying in size on different individuals.

† In some specimens the punctures of the lateral striæ are separated by ridges, but this does not appear to be invariably the case.

‡ As at its base it slightly overhangs the pectoral canal it cannot be called open, although on a first glance it appears to be so.

§ Mr. Waterhouse possibly had a specimen of *cristatus* under examination.

PROTOPALUS CRISTATUS, Pasc.; *l.c.*, No. 5573.

♂. Black, granules slightly shining; antennæ piceous-brown, parts of the mouth (mandibles excepted) pale red. Clothing much as in *dromedarius*, but the scales rather denser, and the sutural crest of the elytra clothed with long sooty-brown setæ, and without the tufts of paler scales at its apex and sides. Pectoral canal feebly squamose. Funicle with a few long hairs inwardly.

Head as in *dromedarius*. Rostrum slightly longer than prothorax, sides feebly and regularly incurved to middle from both base and apex; feebly ridged along middle; each side with two feeble grooves, the ridges separating them irregularly waved; not very strongly punctate, the apex densely punctate except along the middle; beneath with three feeble punctate ridges, the middle ridge with a few small granules. Scape slightly shorter than funicle, inserted at about one-fourth from apex of rostrum; funicle with 1st joint slightly more than half the length of 2nd, and not twice the length of 3rd; 6th-7th feebly transverse. *Prothorax* more rounded than in *dromedarius*, the median carina less elevated in front, and the granules more numerous and regular. *Scutellum* smaller and narrower than in *dromedarius*. *Elytra* about once and one-third the width of prothorax; shoulders thickened but scarcely produced outwardly, and the width across them not much greater than across apical third; suture with a strongly elevated and granulated crest, higher than in *dromedarius*, but not commencing or terminating abruptly, at its apex appearing as part of the posterior declivity; all the interstices with shining granules, except the three outer ones from near the base, the granules largest towards suture and base, the 3rd with a small cluster of granules near base; striate-punctate, the punctures large and round, but rather shallow, except towards the sides: none of the interstices polished. *Mesosternal receptacle* transverse, broad V-shaped, emargination strongly transverse; cavernous. *Legs* moderately long; posterior femora scarcely extending to apex of elytra. Length 14, rostrum 5; width 6½; depth 7 mm.

Hab.—"Queensland" (Pascoe), Endeavour River (Mr. G. Masters).

The differences between this species and *dromedarius* are many and striking, the most noticeable being in the width across shoulders, the crests of the prothorax and elytra, and the granulation of the interstices. Mr. Pascoe says, "the character of the funicle allies it to *Schönherri* rather than to *dromedarius*"; otherwise the antennæ are not even mentioned. The specimen described above, however, agrees with Mr. Pascoe's description as far as it goes, and as it was given to me by Mr. Masters it might be regarded as a cotype.

PROTOPALUS TECTUS, n.sp.

♀. Black, subopaque; antennæ piceous-brown; parts of the mouth (mandibles excepted) of a rather dingy red. Moderately densely clothed with dingy greyish and ochreous scales, more numerous on legs than elsewhere; pectoral canal feebly squamose; apical half of rostrum glabrous; elytral crest (in five specimens) without long setæ. Funicle with fine silvery pubescence.

Head sparsely and feebly punctate; a moderately short shining carina behind ocular fovea; rather strongly excavated between eyes, the derm there being shining and without scales. Rostrum rather short and broad, only the length of prothorax, sides feebly incurved to middle; rather densely punctate, punctures small, along the middle almost impunctate; at base with three feeble ridges and four feeble grooves, the lateral ones terminated before antennæ, the median very short; beneath with three slightly roughened but scarcely elevated lines. Scape the length of funicle, inserted one-third from apex of rostrum; funicle with the 1st joint very slightly longer than the 2nd, 5th-6th feebly, the 7th rather strongly transverse; club moderately large. *Prothorax* somewhat rounded, with a distinct, narrow, shining median carina, moderately strongly elevated in front, but becoming feeble towards base; with numerous moderately large granules, largest and sparsest about middle, densest at base and on flanks, and small on each side of middle towards apex, each granule with a sooty seta. *Scutellum* feebly transverse. *Elytra* about once and one-third the width of prothorax; shoulders thickened, from behind them regularly decreasing to near apex, apex widely rounded; suture raised, but scarcely crested in middle, and with small shining granules; a few small granules at base; seriate-punctate, punctures large, round and moderately deep, larger towards suture than sides, except just behind shoulders, where are the largest of all; lateral interstices highly polished. *Mesosternal receptacle* strongly transverse, somewhat rounded; cavernous. *Legs* long; posterior femora distinctly passing apex of elytra. Length 10, rostrum 2¾; width 4; depth 4¾ mm.

Hab.—N.Q.: Cairns (Macleay Mus.), Cooktown (Herr J. Faust).

I have seen only females of this species, but the small size (in comparison with its congeners) should render the species very distinct; the small sutural crest unadorned with long setæ may be characteristic of the female only. The large excavation between the eyes caused me to think all five specimens were males, but on dissection eggs were discovered.

Genus DYSOPIRHINUS, Roelofs.

Ann. Soc. Ent. Belg. xxiii., C.R. p. xliv. 1880.

Head large, convex, not concealed. *Eyes* large, semicircular, not distant, rather finely faceted. *Rostrum* long and stout, rather strongly curved. *Antennæ* rather long; scape inserted nearer apex than base of rostrum, and shorter than funicle; three basal joints of funicle elongate, 7th adnate to and clothing almost as on club; the latter ovate and with oblique sutures. *Prothorax* longer than wide, sides lightly rounded, base bisinuate, constriction light, ocular lobes obtuse and almost level with apex. *Scutellum* distinct. *Elytra* elongate-cordate, each separately rounded at base. *Pectoral canal* deep and wide, terminated between intermediate coxæ. *Mesosternal receptacle* raised and solid to middle, then the sides thin and sloping to apex, emargination transverse; cavernous. *Metasternum* somewhat shorter than the following segment; episterna distinct. Basal segment of *abdomen* as long as the two following combined, intercoxal process narrow, apex incurved; 2nd the length of 5th, and very little shorter than 3rd and 4th combined. *Legs* long and thin; femora not grooved and feebly dentate, posterior passing elytra; tibiæ thin, curved, apex with a small tooth very close to the terminal hook; tarsi much shorter than tibiæ, 1st and 4th joints rather long, and 4th wide. Elliptic, convex, squamose, winged.

Close to *Protopalus*, but the elytra separately rounded at base, and the shoulders not produced. In its pectoral canal varying in depth it approaches *Orphanistes*. The species described below appears to be new despite its large size. Unfortunately I have been unable to see the original diagnosis of *Dysopirhinus*, but the species described below is certainly congeneric with Dr. Heller's *D. albosparsus* from New Guinea.

DYSOPIRHINUS GRANDIS, n.sp.

Dark reddish-brown, prothorax darker. Moderately densely clothed with ochreous-yellow scales, and with subquadrate patches of sooty scales; each prothoracic granule with a stout scale. Abdomen with sooty scales, with small patches of paler scales at the sides of the four basal segments.

Head feebly punctate, feebly depressed on each side behind the eyes. Rostrum longer than prothorax, rather suddenly bent at apical third, each side of basal half with a ridge bounding the lateral grooves, the ridges becoming very distinct between eyes, ridged along middle to between antennæ; not very densely or coarsely punctate, punctures distinct only on apical third. Funicle with the 2nd joint the length of 3rd and 4th, and considerably longer than 1st, 4th-6th gradually decreasing in length. *Prothorax* slightly longer than wide, subcylindrical, apex more than half the width of base; with a distinct, narrow, shining, continuous, median carina; with numerous large round granules that become smaller towards and disappear on each side of apex. *Scutellum* subcordate. *Elytra* about twice and one-third the length of prothorax, and not much wider at base, where each is separately rounded; with series of large, round, partially concealed punctures, each of which contains a scale; interstices regular, convex, much wider than punctures, each with a series of small and very obtuse granules. *Pectoral canal* much deeper between anterior coxæ (almost the whole of which are exposed) than elsewhere. Metasternum and abdomen very feebly punctate. *Legs*, especially the anterior, long and thin; tibiæ thin, four posterior lightly curved at base, the anterior rather strongly at apical third. Length 19, rostrum 6½; width 8; variation in length 16-19 mm.

Hab.—Queensland (Mr. C. French), Gulf of Carpentaria (Rev. T. Blackburn, No. 4937).

NOTOCRYPTORHYNCHUS, n.g.

Head partially concealed. *Eyes* ovate-triangular, rather coarsely faceted. *Rostrum* moderately long and rather thin, moderately curved. *Antennæ* rather stout; scape the length of funicle, two basal joints of the latter moderately long; club ovate, sutures straight. *Prothorax* feebly transverse, sides rounded, base bisinuate. *Scutellum* distinct. *Elytra* oblong-cordate, wider than prothorax and each separately rounded at base. *Pectoral canal* deep and wide, terminated between four anterior coxæ. *Mesosternal receptacle* rather strongly raised to beyond the middle, sides incurved to base, emargination moderately transverse; cavernous. *Metasternum* slightly longer than the following segment; episterna distinct. *Abdomen* with straight sutures, 1st segment as long as 2nd and 3rd combined, 2nd distinctly longer than 5th and slightly shorter than 3rd and 4th combined. *Legs* moderately long; femora feebly grooved and dentate, posterior not extending to apex of abdomen; tibiæ lightly compressed and almost straight, with a distinct subapical tooth in addition to the terminal hook; tarsi normal. Oblong-elliptic, convex, winged.

Rather close to the preceding genus but differing in the eyes, sterna, abdomen and legs; from *Mecistocerus* (to several species of which the species described below bears a resemblance) it may be distinguished by the sterna; and from *Cryptorhynchus* by the comparatively large second abdominal segment. The sinuated forehead would appear to denote affinity with a number of the allies of *Poropterus.* The species described below is possibly Boheman's *Cryptorhynchus mæstus,* but the elytra of that species are described as trisinuate at the base, with the interstices subconvex and only the posterior femora dentate. It is true that the teeth of the four anterior femora of the specimens now described are very indistinct and might easily be overlooked, but the elytra are decidedly bisinuate at the base, with distinctly raised and narrow interstices.

The genus is apparently close to *Cyamobolus* (numerously represented in the Malay Archipelago and New Guinea), but differs in the rostrum and rounded shoulders.

NOTOCRYPTORHYNCHUS SINUATUS, n.sp.

Black, antennæ dull reddish-brown. Sparsely clothed with elongate subsetose reddish-ochreous scales, but the elytra in addition with narrow transverse fasciæ (almost or quite invisible to the naked eye except posteriorly) of stramineous scales. Sterna and legs with elongate pale scales, four apical segments with stout muddy brown scales not rising above general level.

Head feebly punctate at base, elsewhere distinctly but irregularly punctate; forehead irregularly quadrisinuate; ocular fovea rather large, a feeble ridge extending backwards from its posterior end. Rostrum the length of prothorax; basal half coarsely punctate and with a median carina, apical half shining and much less coarsely punctate. Scape inserted one-third from apex of rostrum; 2nd joint of funicle slightly longer than 1st and the length of 3rd and 4th combined, 4th-7th transverse. *Prothorax* not much wider than long, basal two-thirds subparallel, with a narrow but very distinct and continuous median carina; coarsely punctate, all the punctures confluent, so that the interspaces appear as granules or short irregular ridges. *Elytra* about once and one-third the width of prothorax and twice and one-half its length, each separately rounded at base, sides parallel to near apex, then strongly arcuate to apex; with series of moderately large, oblong, more or less concealed punctures; interstices more or less acutely ridged, the ridges frequently consisting of elongate granules, alternate ones distinctly elevated and lightly curved. *Under surface* with dense and rather coarse punctures, becoming very large on metasternal episterna. *Legs* densely punctate; posterior femora feebly, the others very feebly, dentate. Length 12, rostrum 3; width 6 mm.

Hab.—N. Australia—Queensland (Herr. J. Faust).

The clothing gives the species a very dingy appearance even in perfectly preserved specimens; it is moderately dense only on the scutellum. The 3rd, 5th and 7th interstices are lightly curved at base and again on posterior declivity; the curvature is very distinct to the naked eye but obscure under a lens.

Genus ORPHANISTES, Pascoe.

Journ. Linn. Soc. Zool. x. p. 454, 1869.

Head of moderate size, concealed from above. Eyes large, widely ovate, finely faceted. ***Rostrum*** long and almost straight. ***Antennæ*** thin; scape shorter than funicle, inserted nearer apex than base of rostrum; club thin, joints oblique. *Prothorax* trigonal, base bisinuate, ocular lobes obtuse. ***Scutellum*** subquadrate. ***Elytra*** trigonal, wider than prothorax, widest across shoulders. ***Pectoral canal*** narrow, deep only between the anterior and terminated between the intermediate coxæ. ***Mesosternal receptacle*** sloping from base to apex, elongate U-shaped; very slightly cavernous. *Metasternum* slightly shorter than the following segment; episterna moderately wide. *Abdomen* rather small, intercoxal process narrow; suture between 1st and 2nd feebly incurved, between the others slightly curved outwardly; 2nd segment the length of 5th and but little longer than 3rd or 4th. *Legs* long and thin; femora dentate, not grooved, not passing elytra; tibiæ slightly compressed, tarsi not very long. Subelliptic, strongly convex, squamose, winged.

A very remarkable genus, rather closely allied to *Protopalus*.

ORPHANISTES RUSTICUS, Pasc.; *l.c.* No. 5500.

♂. Black. Clothed with small patches of red scales to which are frequently joined smaller patches of pale yellow scales, their distribution irregular.

Head indistinctly punctate. Rostrum longer than prothorax and almost perfectly straight, slightly swollen near base between antennæ and near apex; indistinctly punctate on basal half, but with four series of small shining irregular granules, between antennæ an impunctate shining space, apical half rather coarsely punctate; a shallow groove connecting scrobe with apex. Funicle with the 2nd joint almost thrice the length of 1st and the length of 3rd-5th, 3rd the length of 4th-5th, 4th slightly longer than 5th, 5th the length of 7th and slightly longer than 6th, 5th-7th the length of club. *Prothorax* longer than wide, sides oblique from apex to near base, with large shallow and irregular punctures or foveæ except on each side of apex; with a very distinct continuous median carina which becomes strongly elevated in front, each side of apex with a short shining ridge; prosternum largely transversely excavated between coxæ and apex, the derm (except towards side and near canal which is here less than half the depth that it is between the coxæ) highly polished and impunctate. *Scutellum* slightly transverse and velvety. *Elytra* about twice the length of prothorax, each separately rounded at base which is considerably wider than prothorax, shoulders projecting, behind them regularly and strongly decreasing in width to apex; seriate-punctate, punctures large and subquadrate but shallow and not distinct; interstices narrow, strongly raised (especially the 3rd and 5th) and shining. *Under surface* indistinctly punctate except for a row on each flank of the metasternum. *Legs* long; posterior femora extending to but not passing apex of elytra, feebly dentate, intermediate shortest, anterior longest; tibiæ thin and slightly shorter than femora. Length 22, rostrum 7½; width 9 mm.

♀. Differs in having the rostrum shorter, slightly but still distinctly curved and its granules and punctures less pronounced; the prothoracic carina is not so highly elevated and the apical ridges are almost obsolete, the excavation of the prosternum is less profound and the femoral teeth are even less distinct.

Hab.—"Queensland" (Pascoe), Rockhampton (Macleay and Sydney Museums).

The most remarkable feature about this species, and which, so far as I am aware, is unique in the subfamily, is the transverse excavation of the prosternum: singularly enough this is not even mentioned by Mr. Pascoe. The small patches of scales are prettily variegated and are frequently confined to single punctures; the largest patches are on each side of apex and each side of the lower flanks of the prothorax, and at basal third and near apex of the elytra; on the abdomen the scales and nude spaces form seven lines; the apex of each of the femora is clothed with reddish scales immediately preceded by a band of pale yellow scales. There are some small blackish scales scattered about, but these are nowhere distinct. The elevations on the front of the prothorax are reminiscent of many of the *Membracidæ*. The pectoral canal is twice the depth between the anterior coxæ that it is elsewhere.

NOTES ON *BYBLIS GIGANTEA*, Lindl. [N.O. *Droseraceæ*].

By A. G. Hamilton.

(Plate xxxvii.)

During a recent visit to West Australia I took the opportunity of seeing Byblis in its natural habitat. Although very numerous in individuals where it does occur, it appears to be restricted to certain localities; and so far as I could ascertain, the occurrence of the plant is determined by well-marked peculiarities of soil. Near Perth I found it most plentiful on the Woodlupin Road, near Cannington, and I was indebted to Mr. H. C. Prinsep, Chief Protector of Aborigines, for an opportunity of visiting the spot. The plant grows on a swampy flat of whitish clay and sand of a very infertile appearance, and its want of fertility was borne out by the fact that almost the only plants flourishing there were Byblis and a fine species of Drosera. The swamp, which was some acres in extent, was surrounded by soil of a rather better character, and on this were many trees and shrubs, mostly Proteaceous and Myrtaceous. The boundaries of the swamp were sharply defined by the line of better and more luxuriant vegetation surrounding it. From information given me by some of the Perth botanists, I believe that Byblis grows only where the soil is similar to that of this swamp—deficient in nitrogenous matter; and that its habits are directly adapted to procuring that necessary material.

On the flat in question both Byblis and Drosera were individually very plentiful. Facing westward when the sun was low, they were a beautiful sight. The Drosera growing to a height of 12-18 inches, and branching freely, had either bright golden-yellow or crimson leaves, translucent and gemmed plentifully with diamond-like drops of secretion. The Byblis plants, though equally plentiful, had leaves too thick for the light to shine through, but each stem and leaf bordered with a shining silvery halo from the drops of liquid on the glands.

The plant is usually about 15 inches in height, but I noticed several of 20 to 25 inches. The stem is stout and branching. The plant is greenish-yellow in all its parts, save that in young leaves about 1½ inches of the tip is crimson. The leaves vary from 4 to 8¾ inches in length, and are three-sided, but with the angles rounded, and bearing a round knob at the apex. The flower is large, bright magenta in colour, the bright yellow anthers forming a striking contrast. At a distance it reminded me of *Cheiranthera linearis* in shape and coloration. Examined more closely, it bears little resemblance to the more open cup-shaped flowers of the Droseraceæ generally. A specimen with pure white flowers was shown to me by Miss Prinsep, who collected it in the same locality. The flowers have been described as salmon-coloured, but I saw none approaching that hue. There is a very good figure in a recent part of Curtis' 'Botanical Magazine' (1).

The stem, leaves, flower-stalks and calyces were all thickly covered with glands, which had captured large numbers of insects, among which I observed ants, small flies and mosquitoes, and a few moths and bugs.

The glands, as Darwin pointed out (2), are of two kinds—long-stemmed and sessile. Both kinds are found in all parts of the plant above ground, except the corolla and its internal whorls.

The pedicellate glands (Pl. xxxvii., figs. 1 and 2) are about 0·018 mm. high, the stalks being slender, thin-walled, hollow and unicellular. There is in many a marked constriction or neck just where they join the head. The head is flat and circular, 0·003 to 0·005 mm. in diameter, and divided into a large number of wedge-shaped cells radiating from the centre (fig. 10). The epidermis forms a pocket of large flat cells (fig. 3) under the base of the pedicel. Darwin says of the pedicels (2):—"The walls are marked with fine intersecting spiral lines, and the pedicel often spirally rolled up." His specimen was dried. I was unable to detect the spiral lines in spirit specimens, and the pedicels were collapsed in all sorts of irregular shapes. But on examining a dried leaf, I saw the spiral lines very plainly. When mounted in glycerine, they are still visible, but very faintly; and in spirit they disappear completely. Among the glands on a dried specimen I saw a few with very small heads, not much larger than the diameter of the stalk. These are probably young undeveloped glands. Darwin says the heads of the glands are purplish, and although I find no mention of it in my notes, I am under the impression that I noticed this in examining the plant with a hand lens. But in both dried and spirit specimens I find that the heads are colourless and transparent.

The sessile glands (figs. 4, 5 and 6) occur in rows down the stem, leaves, etc., the rows being broken every 3 to 8 by stomata, and at longer intervals by pedicellate glands (fig. 7, *pg.*). The heads are slightly flattened spheres, sometimes with a slight projection on top (fig. 5), and are crimson in colour. Each row occupies a shallow groove or channel formed by the epidermal cells on each side of the row being larger in diameter; and where a stoma or a stalked gland occurs, the channel divides and runs on each side of it. The heads are peculiarly divided into sections (fig. 6). They are 0·001 mm. in height and 0·003 mm. in diameter. Darwin observes (*loc. cit.*) that the glandular hairs are far more simple in structure than those of the other genera of Droseraceæ, and do not differ essentially from those borne by innumerable other plants. They certainly do resemble the glandular hairs found in Plumbago, Primula, and some of the Verbenaceæ. As before mentioned, both kinds of glands are found on the flower-stalk and calyx, and are, if anything, more plentiful on these than on the leaves. The plant does not in any respect resemble a Drosera, and it is not at all to be wondered at that some botanists are inclined to place it in another family (1).

The stomata (fig. 8) occur on the stems and leaves, and are 0·003 mm. long and 0·002 mm. wide, the orifice being 0·001 mm.

In the paragraph from which I have already quoted, Darwin says:—"As no instance is known of unicellular structures having any power of movement, Byblis no doubt catches insects solely by the aid of its viscid secretion. These probably sink down besmeared with the secretion, and rest on the small sessile glands, which, if we may judge by the analogy of Drosophyllum, then pour forth their secretion and afterwards absorb the digested matter."

It is a fine illustration of the keen insight of the great naturalist that he should have been able to write so accurate a description, and form so correct a conception of the functions of the glands and their method of action from a dried specimen. There is little to add to the above. When an insect is caught by the stalked glands, these collapse under the weight, and pour out secretion; the victim rests on the sessile glands, and these add to the flow of liquid. This gradually dissolves the solvent portions of the prey, and the secretion runs down the channels in which the sessile glands are seated and is absorbed by them. The liquid flowing down the channels enables the glands which are not in contact with the insect to do a share of the absorption. After all the solvent parts have been removed, the glands cease to secrete; the indigestible parts dry up and drop off as in Drosera. I am inclined to think that the collapsed pedicels again become upright, not through any power of movement, but by becoming turgid by absorption of the secretion. I am led to this belief, first, from noticing how few of the stalks were bent down, even in the vicinity of a captured insect; and secondly, because in a leaf mounted in glycerine many stalks doubled up and lay flat or crumpled, but after a time regained their erect position.

As already mentioned, the leaves are triangular: the widest side is next to the stem. The epidermis is moderately thin, those rows of cells from which the glands emerge being small, and the eglandular epidermis between—generally in two rows of cells—large and circular in section-outline. Inside the epidermis is a layer of palisade and spongy tissue, of three or four rows of cells (fig. 11, *pt.*). The palisade tissue is looser than in ordinary leaves, and the spongy tissue closer than usual, so that it is hard to differentiate between the two layers. Just under the rows of epidermal cells which carry the glands, the palisade cells are closer together, two or three touching each row. The centre of the leaf is occupied by a mass of large-celled pith (fig. 11, *p.*). There are five fibro-vascular bundles, one small, and one larger, in the angles of the side facing the stem, the smaller ones being on the inside of the layer; at the outer angle of the leaf is one bundle much larger than any of the others (fig. 11, *v.*). The bundles are inbedded in the pith, but have only a single row of pith cells on their external aspect, and these cells are smaller than the internal ones. Towards the base of the leaf there are more than five bundles; the leaf has a nearly circular outline there, and serial sections show the bundles widening out, so that at the axil they form an incomplete ring. In the stem, the bundles also form an incomplete ring.

I think that the leaves are really branchlets which have taken on the functions of the leaves.

REFERENCES TO LITERATURE.

(1) CURTIS'S 'Botanical Magazine,' fig. 691, 7846.
(2) DARWIN, C.—'Insectivorous Plants,' p. 343.

EXPLANATION OF PLATE XXXVII.

Byblis gigantea, Lindl.

Figs. 1-2.—Heads of pedicellate glands.
Fig. 3.—Insertion of pedicellate gland.
Fig. 4.—Sessile gland.
Fig. 5.—Sessile gland with projection on apex.
Fig. 6.—Surface view of sessile gland.
Fig. 7.—Surface view (diagrammatic) of epidermis; *pg.*, base of pedicellate gland; *st.*, stoma; *sg.*, sessile gland; *ch.*, channel.
Fig. 8.—Surface view (diagrammatic) of stoma.
Fig. 9.—Section of stoma.
Fig. 10.—Surface view of head of pedicellate gland.
Fig. 11.—Diagram of leaf section; *p.*, pith; *v.*, fibro-vascular bundles; *pt.*, palisade tissue.

[Printed off November 24th, 1903.]

NOTES AND EXHIBITS.

Mr. A. G. Hamilton exhibited in illustration of his paper a dried flowering specimen of *Byblis gigantea*, Lindl., drawings, and sections under the microscope showing some of the more important anatomical characteristics.

Mr. Steel exhibited a specimen of a very rare mineral Greenockite, crystallized cadmium sulphide, which so far has been found only at one locality in Renfrewshire, Scotland, where the example exhibited was obtained; also a good example of *Sigillaria* from the Coal Measures near Glasgow, Scotland.

Mr. G. A. Waterhouse exhibited specimens of *Hypocysta metirius*, Butler (♂), and *H. pseudirius*, Butler (♂), which had been compared by Mr. H. H. Druce with the types in the British Museum; both these belong to the *H. irius* group. *H. antirius*, Butler, which has been variously used for both the species exhibited, Mr. Druce says is allied to *H. adiante*, Hübner, of which *H. undulata*, Butler, is, at best, a variety. *H. epirius*, Butler, is allied to, if not identical with *H. pseudirius*.

Mr. H. J. Carter exhibited some entomological novelties, including representatives of an undescribed species of *Lemidia* (Fam. *Cleridæ*), and of *Egestria* (Fam. *Pedilidæ*); likewise a variety of *Prostomis cornutus* (Fam. *Cucujidæ*) hitherto recorded only from Tasmania. Also a specimen of *Scaraphites macleayi*, Westw., (Fam. *Carabidæ*), found at Darling Point, Sydney, not far from the locality of the type specimen (Mr. W. Sharpe Macleay's garden at Elizabeth Bay, on a portion of which the Society's Hall now stands): this very local form is probably doomed to early extinction in consequence of suburban developments. Mr. Carter also showed a "vegetable caterpillar" forwarded to him by Mr. J. Q. Wood with the information that it was alleged to have been found in a gold mine at Peak Hill, embedded in quartz, at a depth of 150 feet.

Mr. Froggatt exhibited specimens of Nut-grass (*Cyperus rotundus*, Linn.) infested by a scale insect which had been killing off this noxious sedge in the Singleton district during the last three years, but had been brought under the notice of the Department of Agriculture only during the present season. Mr. E. E. Green, of Ceylon, to whom specimens had been sent for identification, says of it, "Your coccid proves to be an *Antonina* very closely allied to *A. purpurea*, Signoret, but distinguished by the presence of a greater number of spinnerets scattered over the derm, and by some small conical processes on the anal lobes. I am calling it *Antonina australis*."

Mr. Maiden sent for exhibition a photograph of the tablet erected many years ago in memory of Richard Cunningham, at Lower Tabratong, near Dandaloo, N.S.W. The stone bears an inscription as follows:—"Richard Cunningham, Government Botanist of this Colony attached to an exploring expedition under command of Major Mitchell, Surveyor-General, wandered in his enthusiasm for botanical investigation from his companions, and losing himself in this locality of the Bogan River, fell into the hands of the Aboriginals, by whom he was unfortunately killed about 25th April, 1835, in the 42nd year of his age. This tablet is erected to his memory by a vote of the Parliament of New South Wales throughout the . . . lands by S. R. Daniel . . . Wellington district." [Some of the letters in the concluding clause are illegible.]

Mr. Fletcher showed branchlets of *Eucalyptus punctata*, DC., gathered a few days ago near Ryde, the foliage of which exhibited much more noticeable quantities of manna than one usually finds on trees of this species in the neighbourhood of Sydney; and he said that it was extremely interesting to observe the avidity with which honey-eaters of two species (*Acanthorhynchus tenuirostris* and a species of *Ptilotis*) availed themselves of this addition to their ordinary food supply.

He also showed a copy of "Voyages de Corneille le Bruyn par la Moscovie, en Perse, et aux Indes Orientales" (1725), the original edition of which in Dutch was published in 1714—a work of interest because of the description and illustration of the Filander, or Aru Island Wallaby (*Macropus brunii*, Schreb.), seen by the author in captivity at Batavia in the year 1706. The figure is still the earliest known of any Australian type of Marsupial. But the Filander has had to give place to the little wallaby of Houtman's Abrolhos (probably *Macropus eugenii*, Desm.) as the first Macropod which so far is known to have revealed itself to European eyes, for the recently published investigations of Professor Heeres* show that, so long ago as 1629, Commodore Pelsaert—whose ship, the "Batavia," was wrecked on one of the islands in June of that year—had observed and noted the pouched character, and the mammary fœtus of the wallaby in question.

The much less satisfactory observations of Vlaming and Dampier on West Australian wallabies, belong to the last decade of the seventeenth century.

Mr. Cheel exhibited a very fine collection of Lichens, comprising the following forty-seven species or varieties not represented in the Rev. F. R. M. Wilson's "List of Lichens found in New South Wales" (Proc. R. Soc. Queensland, vi., p. 89):—

Physma byrsinum, Ach.—Richmond River (F. R. M. Wilson; July, 1894).

Synechoblastus aggregatus, Ach.—Big Scrub, Richmond River (F. R. M. Wilson; July, 1894).

Pyrgillus javanicus, Nyl.—Richmond River (F. R. M. Wilson; July, 1894).

Calicium hyperellum, Ach.—Berowra (E. Cheel; August, 1902).

Coniocybe bæomycioides, Mass.—National Park (E. Cheel; October, 1902).

Stereocaulon nanum, Ach.—Waterfall (E. Cheel; June, 1901).

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* "The Part borne by the Dutch in the Discovery of Australia, 1606-1765. By J. E. Heeres, LL.D., Professor at the Dutch Colonial Institute, Delft." Published by the Royal Dutch Geographical Society in commemoration of the xxvth anniversary of its foundation. Leiden (1899).

Cladonia gracilis, Ach.—Blackheath (A. Hamilton; October, 1900).

C. delicata, Flk., f. *quercina*, Wain.—Penshurst and Waterfall (E. Cheel; March, 1901); Mount Wilson (J. Gregson; February, 1903).

C. furcata, var. *pinnata*, Wain.—Crawford River, Bullahdelah (E. Cheel; October, 1902); Waratah, Newcastle (J. Gregson; July, 1903).

C. racemosa, Flk.—Blacktown (F. R. M. Wilson; August, 1894); Wahroonga (W. Buckingham; July, 1899); Peakhurst (E. Cheel; September, 1900).

C. digitata, Hoffm.—Randwick (E. Cheel; July, 1900).

C. cornucopioides, Fr., var. *pleurota*, Wils.—Guntawang (A. G. Hamilton; June, 1884); Blackheath (F. R. M. Wilson and A. Hamilton); Mount Kosciusko (J. H. Maiden and W. Forsyth).

Bœomyces fusco-carnea, Wils. (?)—Blackheath (A. Hamilton; October, 1900). Stipes are much longer than in Wilson's specimens. The thalline margin of the apothecia, and the chemical reaction (KHO, yellow then red) are the same. May possibly be a good variety.

Neuropogon melaxanthus, Nyl. — Mount Kosciusko (J. H. Maiden; January, 1899).

Usnea barbata, var. *scabrida*, (Tayl.) Müll. Arg.—Peakhurst and Tia Falls, New England (E. Cheel; July, 1900); Gulgong (J. H. Maiden and J. L. Boorman; April, 1901).

U. barbata, var. *furruginascens*, Müll. Arg.—Penshurst and Crawford River (E. Cheel; October, 1902); Clarence River (J. Thompson; January, 1901).

U. angulata, Ach.—Clarence River (J. Thompson).

Ramalina leiodea (Nyl.) Müll. Arg.—Peakhurst (E. Cheel; October, 1901).

R. leiodea, var. *fastigiata*, Müll. Arg.—Peakhurst and Sutherland (E. Cheel; October, 1901).

R. polymorpha, var. *emplectens*, Ach.—Blackheath (A. Hamilton; October, 1900); Jenolan Caves (F. R. M. Wilson; September, 1897).

Thamnolia vermicularis, Schær.—Mount Kosciusko (J. H. Maiden; January, 1899).

Nephromium lævigatum, Ach.—Jenolan Caves (H. Malthouse; August, 1898).

Ricasolia plurimseptata, C. Kn.—Big Scrub, Richmond River (F. R. M. Wilson; July, 1894); Stanwell Park (E. Cheel; August, 1902).

Stictina quercizans, var. *cervicornis*, Flot.—Waterfall and Stanwell Park (E. Cheel, June, 1901); Otford (J. L. Boorman; September, 1901).

Sticta Karstenii, var. *linearis*, Müll. Arg.—East Maitland (Mr. Thompson).

S. endochrysea, Del., var. *flavicans*, Müll. Arg.—Waterfall (E. Cheel; June, 1901); Otford (E. Cheel and J. L. Boorman; September, 1902). Previously recorded by Wilson (Proc. Roy. Soc. Queensl. (1889) as *Sticta urvillei*, var. *flavicans*, Hook. et Tayl.).

S. filix, var. *myrioloba*, Müll. Arg.—Three-Mile Scrub, Byron Bay (W. Forsyth; November, 1898); Bullahdelah (E. Cheel; October, 1902).

Parmelia ciliata, Ach.—Peakhurst and Otford (E. Cheel; September, 1900); Hastings River (J. H. Maiden); Newport (F. R. M. Wilson).

P. conspersa, var. *laxa*, Müll. Arg.—Throughout the State (various collectors).

P. conspersa, var. *stenophylloides*, Müll. Arg.—Sutherland and Heathcote (E. Cheel; October, 1901).

P. adpressa, Krp. (Syn. *P. amplexula*, Stirt.).—Hurstville (E. Cheel; September, 1902).

P. olivacea, L.—South Head, Sydney (E. Cheel; May, 1901).

P. olivacea, var, *prolixa*, Ach.—Beaudesert Hills, Guntawang (A. G. Hamilton; July, 1885).

P. olivacea, var. *exasperata*, Ach.—Como (E. Cheel; August, 1900).

P. pertusa, Schrank (Syn. *P. diatrypa*, Tayl.)—Mount Victoria (A. G. Hamilton and E. Cheel); Penshurst (E. Cheel; May, 1901).

Pannaria lurida, Mtn.—Mount Wilson (J. Gregson; February, 1903); Waterfall (F. R. M. Wilson and E. Cheel).

Psoroma soccatum (R.Br.), Cromb.—Mount Wilson (J. Gregson; February, 1903).

Pyxine cocoes, Sw.—Penshurst (E. Cheel; June, 1901).

Coccocarpia rufescens, Wils.—Waterfall (F. R. M. Wilson and E. Cheel); Otford (E. Cheel and J. L. Boorman); National Park (E. Betche).

Phyllopsora melanocarpa, Müll. Arg.—Jenolan Caves (F. R. M. Wilson; September, 1897); Parramatta (E. Cheel; October, 1901); Mount Wilson (J. Gregson; April, 1902).

Callopisma cinnabarinum, Ach.—Tia Falls, New England (E. Cheel; October, 1900).

Candellariella vitellina, Ehrh.—Lithgow (F. R. M. Wilson; September, 1897); Riverstone Park, Penshurst (E. Cheel; May, 1901).

Lecidea myriocarpa, DC.—Centennial Park (E. Cheel; September, 1900).

Patellaria (Bilimbia) phyllocharis, Mtn.—On leaves of plants, Waterfall, Berowra, and Crawford River, Bullahdelah (E. Cheel).

Lecidea (Eulecidea) contigua, Fr.—Peakhurst and Como (E. Cheel; September, 1900).

Rhizocarpon geographicum (Schær.), DC.—Mount Victoria (E. Cheel; December, 1900).

Biatorinopsis lutea (Dicks.), Müll. Arg.—Lawson, Blue Mountains (A. Hamilton; November, 1901); Penshurst (E. Cheel; October, 1901).

WEDNESDAY, SEPTEMBER 30TH, 1903.

The Ordinary Monthly Meeting of the Society was held in the Linnean Hall, Ithaca Road, Elizabeth Bay, on Wednesday evening, September 30th, 1903.

Mr. Henry Deane, M.A., F.L.S., &c, Vice-President, in the Chair.

Mr. F. **Grant**, Union Bank, Pitt Street, was elected a Member of the Society.

The Donations and Exchanges received since the previous Monthly Meeting, amounting to 13 Vols., 72 Parts or Nos., 13 Bulletins, 2 Reports, 11 Pamphlets, and 2 Miscellanea, received from 55 Societies, &c., and 4 Individuals, were laid upon the table.

THE FLORA OF NORFOLK ISLAND.

PART I.

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In the years 1804 and 1805 Ferdinand Bauer visited Norfolk Island (*infra*, p. 778), and his collections and drawings were submitted to Endlicher, of Vienna, who in 1833 published a Prodromus of the plants, describing a number of new species. In 1830, Allan Cunningham visited the Island and added to our knowledge of its botany; his notes were posthumously published by Heward. Thenceforward notes on the botany of the Island, usually of a popular character, were published by various authors noted in the Bibliography. In 1885, the late Baron von Mueller published, in the 'Journal of Botany,' notes on the botany of the Island based upon specimens callected by Mr. Isaac Robinson, then, as now, resident agent for the Sydney Botanic Gardens. Since I have had control of this establishment, I have, chiefly with Mr. Robinson's aid, continuously made collections of the flora. To Mr. Robinson's work I am highly indebted. Before publishing, I determined to visit the Island, not only to endeavour to clear up a number of difficulties that had presented themselves, but also to see if I could find any plants not hitherto recorded. I have recounted my results as regards the first object during the course of the paper. As regards the second object, I desire to refer my readers to the summary of results.

I visited the Island in November, 1902, after a period of (for the Island) severe drought, hence the time was unsuitable for some species; at the same time the great dryness enabled me to visit situations that would have been difficult of access in a wet or even a normal season. I was accompanied by Mr. J. L. Boorman, Collector for the Botanic Gardens, whose zeal in this service is worthy of the highest praise.

It being obvious that it is essential that deductions as to the origin and distribution of a flora should be based on accurate determinations of the species, I desire to say that this Part chiefly concerns itself with systematic work; I have a few queries which are not yet settled, and when this is done to my satisfaction I hope to submit the deductions referred to.

As it is seventy years since Endlicher's valuable though incomplete Flora of the Island was published, and in view of the very scattered literature of the botany of this very interesting ocean island, I trust that the present contribution may be found useful.

"Stick" is the term used in Norfolk Island for what on the mainland is universally known as the "bush."

SECTION i.

A. PHANEROGAMÆ.

i. ANGIOSPERMÆ.

a. Dicotyleæ.

RANUNCULACEÆ.

1. CLEMATIS GLYCINOIDES, DC.—New for the Island.

"*Clematis indivisa*, Willd., in Dec., Prod. v. 1, p. 5. *C. integrifolia*, Forst. non Linn. Common on the Cascade Road," is quoted from Allan Cunningham's Notes by Heward (10, p. 121) as having been found by Cunningham in Norfolk Island, but I did not find it. Perhaps a slip of the pen for *C. glycinoides*, DC.

"*C. cocculifolia*, A. Cunn., in Ann. Nat. Hist. ser. i. iv. 260, from Norfolk Island. . . . . has most of the leaves simple and orbicular" (B.Fl. i. p. 7). This is a New Zealand species, and its occurrence on Norfolk Island should be confirmed.

2. RANUNCULUS PARVIFLORUS, Linn.—In mud at the Cockpit and in many other places. New for the Island.

MAGNOLIACEÆ.

Drimys Howeana, F.v.M.,Fragm. vii. 17, is recorded from Norfolk Island by Tate. I have not seen a specimen.

MENISPERMACEÆ.

Stephania discolor, Spreng., Syst. iv. Cur. Post. 316 (*S. hernandiæfolia*, Walp.*), occurs in Lord Howe Island and in many places to the north of Norfolk Island, but I am not aware that it has been recorded for the latter Island.

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* This name is given in B.Fl. i. 57, and in "Die Flora der Deutscher Schutzgebiete in der Südsee" (Schumann and Lauterbach).

CRUCIFERÆ.

3. **Nasturtium sylvestre**, R.Br., "in Hort. Kew. v. 4, p. 110, Ed. 2, Eng. Bot. t. 2324. Wet ravines and running streams" (A. Cunn., in Heward).

4. **Cakile maritima**, Scop.—New for the Island.

CAPPARIDEÆ.

5. **Capparis nobilis**, F.v.M. (Syn. *Busbeckia nobilis*, Endl., Prod. Norf. 64; *Capparis citrina*, A. Cunn., London Journ. Bot. i. 115, 1842).

Capparis nobilis, F.v.M., B.Fl. i. 95, 1863, refers to "a small tree." Endlicher says "Frutex an arbuscula?" he being evidently in doubt. The Norfolk Island plant (found also in Phillip Island, see p. 784) is in fact a stout scrambling climber, with a stem 3 inches in diameter, and of indefinite length, forming a liana amongst the trees at Ball's Bay.

The differences between the Norfolk Island and Australian Capparides are here stated :—

NORFOLK ISLAND.	AUSTRALIA.
Tall, scrambling or climbing shrub.	Erect, tall shrub or tall tree.
Leaves : proportion of length to breadth 2 to 1.	Leaves : proportion of length to breadth 3 to 1 or narrower. (One broad-leaved specimen from Queensland in the National Herbarium, Sydney).
Inflorescence terminal in all specimens, though described as flowers on solitary axillary peduncles or in terminal racemes by reduction of the leaves.	Inflorescence more frequently axillary, the peduncles frequently in pairs.
Flower buds rather more pointed. Colour of the flowers pale yellow.	Buds more globular, though often pointed. Colour white.
Fruit almost globular.	Fruit lemon-shaped, often with crested ridges.

The difference between the two Capparides appears to be more in habit than in any essential character, so that it may be a matter of opinion whether they should be looked upon as distinct species or only varieties.

In my opinion the name *C. nobilis* should be retained for the Norfolk Island plant, and *C. arborea* (F.v.M., Fragm. i. 163) for the mainland one until it is shown that the two are identical.

C. ornans, F.v.M., is a Queensland plant (from Port Denison) closely allied to *C. nobilis*, and is, like the Norfolk Island one, a woody climber. The position of this species should also be enquired into, although according to Bentham they belong to different sections of the genus.

In the Index Kewensis we have *Busbeckia arborea*, F. Muell., Fragm. i. 163 = *Capparis nobilis.*

Busbeckia nobilis, Endl., Prod. Fl. Ins. Norf. 64 = *C. ornans*, but I do not know on what authority. Bailey, 'Queensland Flora,' does not touch on the point, and I have not sufficient material to clear up the whole matter.

Pax (in Pfl. Famil.) divides *Capparis* into 14 sections. He has:—

> "Sect. xii. *Busbeckia*, Benth., to which belongs the typical *C. elegans*, (Endl.) F.v.M., upon which Endlicher has founded his genus *Busbeckia*, from Norfolk Island and Australia."

Capparis elegans, (Endl.) F.v.M., must be a clerical error; in my opinion Pax meant to write *C. nobilis*, (Endl.) F.v.M. In Endlicher's Prod., the plant is called *Busbeckia nobilis*, Endl., as already stated, and *Capparis* or *Busbeckia elegans* is nowhere to be found.

VIOLACEÆ.

6. HYMENANTHERA LATIFOLIA Endl., Prod. Norf. 127.—This is one of the small trees known as "Beech" on the Island.

> "*Hymenanthera oblongifolia*, A. Cunn. MSS. (nov.sp.) foliis oblongis, basi attenuatis petiolatis, margine calloso-denticulatis. A slender shrub bearing fruit in July, on the skirts of woods at Long Ridge, at the junction of the old cross road leading to Cascade Road" (A. Cunn. in Heward, 10 p. 124).

This is a synonym of *H. dentata*, R.Br., but I think that a second species of *Hymenanthera* has not been proved to occur on the Island.

7. **Melicytus ramiflorus**, R. & G. Forster.—Recorded for the Island by Sir Joseph Hooker in Handbook of N.Z. Flora, p. 17, and later by Mueller (Journ. Bot. xxiii. 354). It is a tree of the habit of the better known *Olea apetala* (Ironwood).

8. **Viola betonicæfolia**, Sm.—Recorded in B.Fl. i. 99, as having been collected by Backhouse.

PITTOSPOREÆ.

9. **Pittosporum bracteolatum**, Endl., Prod. Norf. p. 78.—This bears the absurd name of "Oleander" on the Island.

FRANKENIACEÆ.

10. **Frankenia pauciflora**, DC.—New for the Island.

PLUMBAGINEÆ.

11. **Plumbago zeylanica**, Linn., Endl., Prod. Norf. 87.—Found by A. Cunningham on Phillip Island also. This species extends from the East Indies through the Malay Archipelago to Australia and the Pacific Islands (including the Sandwich Islands). At the same time, bearing in mind that for so many years this has been extensively distributed as an ornamental plant by the Sydney Botanic Gardens, a word of caution is necessary in accepting it as indigenous in some of the Pacific Islands.

GUTTIFEREÆ.

Calophyllum inophyllum, Linn.—I was told that this tree is found on the Island, but I could not find it and would suggest that the foliage of *Ochrosia* has been taken for it.

MALVACEÆ.

12. **Malvastrum tricuspidatum**, A. Gray.—New for the Island.

13. **Abutilon Julianæ**, Endl., Prod. Norf. 135.—This rare endemic plant I found in only two localities, which need not be particularised. It is a shrub about 4 feet high, and as cattle are fond of it and roam freely, it is in some danger of extinction. I brought cuttings to endeavour to introduce it to cultivation. It is not of horticultural value.

14. **Hibiscus diversifolius**, Jacq., Endl., Prod. Norf. 133.

15. **Hibiscus tiliaceus**, Linn., Endl., Prod. Norf. 131.

16. **Hibiscus insularis**, Endl., Prod. Norf. 132.—Found only on Phillip Island (called Pig Island by Endlicher). A few stilt-like plants remain, almost the last of the vegetation.

17. **Lagunaria Patersonii**, Don, Endl., Prod. Norf. 134 (with a full synonymy).—Found also on Phillip Island (A. Cunn. in London Journ. Bot. i. 116).

> "Scattered on the grassy hills it forms a spreading tree of forty feet in height; it is here called White Oak; its leaves are of a whitish green, and its flowers pink, fading to white, the size of a wine-glass. It is perhaps the largest plant known to exist, belonging to the Mallow tribe. In a thick wood I met with it eighty feet high, and with a trunk sixteen and a half feet round" (Backhouse, p. 258).

It is valueless for economic purposes except as an inferior firewood, it being one of the few woods of the Island little used for that or any other purpose. Trees 5 feet in diameter are common. It has very large, handsome flowers of a very deep pink, much more ornamental than those of the same species on the mainland, which is var. *bracteata*, Benth., B.Fl. i. 218.

STERCULIACEÆ.

18. **Ungeria floribunda**, Schott & Endl.—"Bastard Oak" [probably in comparison with the "White Oak" (*Lagunaria*)]. Endemic. A tree 40 feet in height and with a diameter of 18 inches to 2 feet. The saplings grow very straight and tough, and are hence used by the boys for fishing-rods.

LINEÆ.

19. **Linum marginale**, A. DC.—New for the Island.

GERANIACEÆ.

20. **Pelargonium australe.**—New for the Island.

20 *bis*. **Geranium dissectum**, Linn.—New for the Island.

RUTACEÆ.

21. **Evodia littoralis**, Endl., Prod. Norf. 146.—Found at "Now Now." Called "Shade-tree" on the Island. Apparently rare. Originally recorded from Anson Bay. Bailey, 'Queensland Flora,' i. 201, diffidently records this species from Queensland also.

22. **Acronychia Endlicheri**, Schott. (Syn. *Vepris simplicifolia*, Endl., Prod. Norf. 148).—Called "Big or Dark Yellow Wood."

23. **Xanthoxylum Blackburnia**, Benth., B.Fl. i. 363. (Syn. *Blackburnia pinnata*, Forst., Charact. Gen. 6; Forst., Prod. p. 10. "Norfolciæ insula deserta," Endl., Prod. Norf. 147.)

"Small or Hard Yellow Wood." Formerly much used for making household furniture. Found also on Phillip Island.

Boronia Barkeriana, F.v.M.

Eriostemon ambiens, F.v.M. (*Phebalium ambiens*, F.v.M.).

Eriostemon Beckleri, F.v.M. (*P. Beckleri*, F.v.M.).

Bosistoa euodiformis, F.v.M.

These are four New South Wales species which have been copied into Prof. Tate's List, probably through a clerical error. *Bosistoa euodiformis* and *Eriostemon Beckleri* are from the mainland, and may possibly be found on the Island, although I think it is very unlikely. The other two species are more unlikely still, and could not be admitted except on the clearest evidence, which I think it is quite impossible to produce.

MELIACEÆ.

24. **Dysoxylon Patersonianum**, Benth. & Hook. f. (*Hartighsea Patersoniana*, Endl., Prod. Norf. 139).—Called "Shark" because of the unpleasant smell of the tree. Probably the tree thus referred to by Downing—"Among the many ornamental woods obtained from this ocean isle should be enumerated the rose-wood, believed to be a species of Acacia" (p. 204).

I sent a specimen of this plant to Prof. L. Radlkofer, of Munich, who favoured me with the following interesting note upon it :—

"I obtained from Vienna the original plant of Endlicher, as I supposed what Endlicher called an 'arillus' might have been, as on your plant, only *a thin external fleshy layer of the testa*, and really so it was, and the specimen of Endlicher, which lies before me as I write, shows in every respect full identity with your specimen also in the number of *only* 1 *ovulum* in each cell of the germen and in the anatomical characters of the leaflets (as noted in my previous letter and sketch. (See Plate xxxviii.).

"There remains only, as in your plant, some doubt about the (tubular ?) disk surrounding the germen; for also in the specimen of Endlicher it seems to be destroyed by the accrescence of the germen, as all the flowers have passed over in young fruits.

"This is also the reason why Endlicher has taken the short relic of the style for the (fallen off) style (and stigma) itself.

"What he says about the petals and staminal tube, he has taken from a somewhat incomplete (unpublished) drawing of Bauer, which I have seen too, but which gives no clearness about these things.

"Endlicher had not seen ripe seeds, so his description may be completed by the following (taken from your plant) :—

"Semina ovata, basi truncata callosaque, testa subdrupacea, strato tenuii carnoso (ab Endl. 'arillus' dicto) in cellulis exterioribus materiam flavidam tannino quodammodo affinem in interioribus amylum gerente obducta, dorso sulco levi (rimæ intercotyledonari respondente) notata; embryo rectus inversus; cotyledones semi-obovoideæ, plano-convexæ sat crassæ, basi versus angustatæ, lateraliter juxtapositæ, fusco-olivaceæ, amylo foetæ cellulisque secretoriis sparsis instructæ; radicula parva (supera), inter cotyledones omnino retracta; plumula pilosa glandulisque minutis clavatis breviter stipitatis adspersa (ad modum *Dysoxyli Lessertiani*, Benth., A. C. DC., Bull. Soc. Bot. France, xxii. 1875, p. 231, fig. 3 delineati.")

OLACINEÆ.

25. **Pennantia corymbosa**, Forst., Charact. Gen. 67 (described from New Zealand); Endl., Prod. Norf. 140. (Syn. *P. Endlicheri*, in Linnæa xvi. 341, t. 13, 1842.)

Index Kewensis has "*Pennantia Endlicheri*, Reiss., in Linnæa xvi. 1842, 341, t. 13, synonymous with *P. corymbosa*, Endl., Prod. Norf. p. 80.

"*P. corymbosa*, Forst., Char. Gen. 134, New Zealand."

In Endlicher's Prod. Norf. the plant is called *Pennantia corymbosa*, Forst., Char. Gen. 67; but in Index Kewensis *P. corymbosa*, Forst., is stated to be from New Zealand, and *P. corymbosa*, Endl., from Norfolk Island.

I am of opinion that the Norfolk Island species is identical with the New Zealand one.

CELASTRINEÆ.

26. ELÆODENDRON CURTIPENDULUM, Endl., Prod. Norf. 141.—See my note on this species in these Proceedings, 1898, p. 125. Found also in Lord Howe Island. Called "Maple" on Norfolk Island.

SAPINDACEÆ.

27. DODONÆA VISCOSA, Linn.—A. Cunningham (*op. cit.*) has the note "*Dodonæa spathulata*, Sm., in Rees' Cyc. v. 5, p. 12, n. 2. *D. viscosa*, Forst., non Linn. Sides of Mount Pitt."

A manuscript in my possession (circa 1844) says, "Hopwood (*Dodonæa orientalis*) does not attain to more than a foot in diameter, and is principally used for veneering and turning ornaments."

It is called "Ti-tree" by some and by others "Ake-Ake" who remember the same species from New Zealand.

It is a singularly handsome small tree, reminding one of an Oleander, and bearing a profusion of crimson winged fruits. It is to be found on a bank of rocks in the vicinity of Bullock's Hut, north-west of the Island. Hemsley (Ann. Bot. x. 234) has the record for Lord Howe Island, "*Dodonæa lanceolata*, F.v.M. (*D. viscosa*, C. Moore, Rep. p. 3 vix Linn.)."

I have carefully examined our specimens, and those from Norfolk Island are all *D. viscosa*, and those from Lord Howe Island are all *D. lanceolata*.

A manuscript in my possession has the entry "Maple (*Acer Dobinea*) is also very handsome and used for cabinet work." Downing also has "The Maple (*Acer Dobinea* ?)." Probably *Dodonæa viscosa* is referred to. The "Maple" of the islanders (post-Pitcairn) is *Elæodendron curtipendulum*, Endl

LEGUMINOSÆ.

28. MILLETIA AUSTRALIS, Benth., in Miq., Pt. Jungh. 250. (Syn. *Milletia* (*Wistaria*) *Camerana*, F.v.M., Journ. Bot. xxiii. 353, 1885: *Milletiana Maideniana*, Bailey, Bot. Bull. v. 1892; Queensland Flora, 396: *Wistaria australis*, F.v.M., Journ. Bot. xxii. 290, 1884: *Pterocarpus australis*, Endl., Prod. Norf. 152).

I am of opinion that the above are specifically identical.

For some notes on *M. australis*, *M. megasperma* and *M. Camerana*, see Mueller in Journ. Bot. xxiii. 353.

The Norfolk Island plant rarely fruits. Mr. J. Robinson has only seen three fruits (one of which is in my possession) during his very long sojourn on the Island. They are identical with those of *M. Maideniana*.

Endlicher did not see the fruits, and he called it "frutex v. arbuscula"; it is really a rampant climber.

"The road was chiefly through thick forest, overrun with luxuriant climbers. Among them was a *Wistaria*, with pea-flowers, of purple and green, and leaves something like those of the Ash. It hangs in festoons of twenty or thirty feet, from the limbs of the trees that support it" (Backhouse, 258).

It is a very tough climber, hence the people call it "Samson's Sinew." It helped to form the almost impenetrable brush which rendered traffic through the Island so difficult in the early days. Accounts of the extraordinary denseness of the vegetation are traditional, and can be well understood.

29. GLYCINE TABACINA, Benth.—New for the Island.

30. CANAVALIA OBTUSIFOLIA, P. DC. (Syn. *C. Baueriana*, Endl., Prod. Norf. 50).—This plant is probably referred to in the following passage:—"In the evening of yesterday the sawyer, his assistant, and ye carpenter was poisoned, by eating some beans which had a very tempting appearance much like ye broad Windsor bean; they have been so ill as not to do any work to-day." (Lieut. Govr. King, 8th May, 1788, in Hist. Rec. N.S.W. ii. 568). A purple-flowered runner on the coast, and reputed poisonous in Australia (see my 'Useful Native Plants of Australia,' p. 12).

Found by Cunningham on Phillip Island as well as on Norfolk Island.

31. VIGNA RETUSA, Walp., Repert. Bot. Syst. i. 778, 1842. (Syn. *V. lutea*, A. Gray, Bot. Amer. Expl. Exped. i. 454, 1854 : *V. lutea*, A. Gray in B.Fl. ii. 259, apparently through an oversight : *Callicysthus volubilis*, Endl., Prod. Norf. 149).

32. CÆSALPINIA BONDUCELLA, Fleming. "*Guilandina Bonduc*, Linn., Lam. Ill. t. 336.—In the woods between Long Ridge Farm and the south-west coast" (A. Cunn. in Heward, p. 123).

33. STREBLORRHIZA SPECIOSA, Endl., Prod. Norf. 151. Heward (from A. Cunningham's notes) states :—"(*Streblorrhiza speciosa*, Endl., Prod. p. 97, is *Clianthus Baueri*, A. Cunn. MSS. *C. carneus*, Lind., in Bot. Reg. Sept. 1841, t. 51)." Also the *Clitoria sp.* of A. Cunn., London Journ. Bot. i. 115, 1842.

Bentham (B. Fl. ii.) alludes to *Streblorrhiza* as "the very distinct genus." It was found on Phillip Island, but the species is now extinct. I believe there is only one original drawing in existence. It is by Bauer and is at the British Museum or Vienna. There is a coloured drawing in Edwards' Botanical Register (Lindley) 1841, under the name of *Clianthus carneus*, Lindl. From one of the "Miscellaneous Notices" in the same volume, No. 9 (not 7), Lindley's figure was prepared from a specimen cultivated by Mr. Pince of Exeter. It would be interesting to learn if the plant is wholly extinct, even from cultivation.

MYRTACEÆ.

34. RHODOMYRTUS PSIDIOIDES, Benth.—New for the Island. If not planted it is apparently the only indigenous myrtaceous plant on the Island.

Metrosideros polymorpha, Gaud., is in Tate's List, but I could only find a planted tree (in the Melanesian Mission Garden). It is what may be called a "probable species." Hooker (Handbk. Fl. N.Z. p. 73) has the note "abundant throughout all the Pacific Islands and New Caledonia." It occurs on Lord Howe Island.

LYTHRARIEÆ.

35. LYTHRUM HYSSOPIFOLIUM, Linn.—It would appear that this plant has not been previously recorded from the Island.

PASSIFLOREÆ.

36. PASSIFLORA BAUERIANA, Mast., Trans. Linn. Soc. xxvii., 634, 1871. (Syn. *Disemma Baueriana*, Endl., Prod. Norf. 123 : *Murucuia Baueri*, Lindl., Coll.* t. 36).

This is the synonymy as given by Dr. Masters himself, who, following Endlicher, records it from Norfolk Island.

37. PASSIFLORA GLABRA, Wendl., Coll. Plant i. 55, t. 17, 1805. (Syn. *P. adiantifolia*, Ker, Bot. Reg. t. 233 : *Disemma adiantifolia*, DC. Prod. iii. 333).

This is the synonymy given by Masters (Trans. Linn. Soc. xxvii. 634). He records this species from Norfolk Island. Under the name of *Disemma adiantifolia*, DC., the species is recorded in Endl., Prod. Norf. 122, and Endlicher gives the additional synonyms *P. aurantia*, Andr., Bot. Reposit. t. 295, non Forst. nec Cav. : *P. adianthum*, Willd., Enum. 698. He also states that it is lacking in Bauer's herbarium (the one, of course, which formed the basis of Endlicher's work), that it grows in Norfolk Island, and that it has been growing in English gardens since the year 1792.

Backhouse (p. 268), says :—"Among the bushes there are *two pretty species* of Passion Flower, *Disemma adiantifolia* and *D. Baueriana*, with copper-coloured blossoms."

Endlicher places *P. adiantifolia* in the Section "Petioli glandulosi," and *P. Baueriana* in the Section "Petioli apice glandulosi."

The specimens collected by Mr. Robinson, and Mr. Boorman and myself are all referable to *P. glabra*, Wendl. The flowers are orange-coloured, the calyx eventually becoming crimson.

I could not find a second species, although I diligently searched for it. I would urge residents of the Island to favour me with specimens of *D. Baueriana*, Mast., if they can now find it; and also a few ripe fruits of both species in order that I may raise some plants. The difference in the colours of the flowers and fruits of the two species should be noted.

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* Probably "Collectanea botanica," London, 1821, fol. A work which I have not been able to consult.

There is plenty of the common Passion Vine (*Passiflora edulis*) growing wild.

CUCURBITACEÆ.

38. BRYONOPSIS AFFINIS, Cogn., in DC. Monogr. Phan. iii. 479. (Syn. *Bryonopsis Pancheri*, Naud., and *Bryonia affinis*, Endl., Prod. Norf. 125).

39. SICYOS ANGULATA, Forst., Prod. 1796. (Syn. *S. australis*, Endl., Prod. Norf. 124, 1833).—Called "Cucumber" on the Island.

40. MELOTHRIA BAUERIANA, F.v.M., Fragm. vi. 188, 1866. (Syn. *Zehneria Baueriana*, Endl., Prod. Norf. 126; *Zehneria Baueriana*, in Benth. & Hook., Gen. Plant. i. p. 830).—Called "Giant Cucumber" on the Island.

FICOIDEÆ.

Mesembryanthemum australe, Sol., Endl., Prod. Norf. 129.—I made diligent search for this species, but failed to find it. I have not the German edition of Hunter quoted by Endlicher.

41. MESEMBRYANTHEMUM ÆQUILATERALE, Haw. ("Pigs' Faces"), is not uncommon.

42. TETRAGONIA EXPANSA, Murray, in Comm. Gotting. vi. 13, 1783, not Solander as given in Endl., Prod. Norf. 130.—Called "Cook's Cabbage" on the Island.

Endlicher recognises two varieties, *cornuta* and *strongylocarpa*, on the Island. The specimens collected by me belong to the latter form; so do those in the herbarium from Lord Howe, New Zealand and Australia. The form *cornuta* (floribus sessilibus) appears to be rarer, but I have not seen it, and do not know whether Endlicher's varieties have been accepted by others.

UMBELLIFERÆ.

43. **Apium prostratum**, Labill. (*S. australe*, Thouars).—Called "Wild Celery."

44. **Apium leptophyllum**, F.v.M,—New for the Island.

ARALIACEÆ.

45. **Meryta latifolia**, Seem., Bonplandia, 1862, p. 265. (Syn. *Botryodendron latifolium*, Endl., Prod. Norf. 119. See also F.v.M., Fragm. ix. 169).—Called "Shade-tree" on the Island. It is now rare.

"Here also, as well as in most of the other shady woods throughout the island, *Botryodendron latifolium*, a shrub of singular form, allied to the Ivy, but of a very different appearance, prevails. Its figure may be compared to that of a long-leaved cabbage, mounted on a broom-stick. Its stem is about five feet high, and five inches round; its largest leaves are about two feet long, and one foot broad. The prisoners in the out-stations wrap their bread in these leaves, and bake it in the ashes. The fruit is a dense cluster of greenish purple berries, not edible, produced in the centre of the crown of leaves" (Backhouse, p. 270).

46. **Meryta angustifolia**, Seem., Bonplandia, 1862, 295. (Syn. *Botryodendron angustifolium*, Endl., Prod. Norf. 120. See also F.v.M., Fragm. ix. 169).

RUBIACEÆ.

47. **Coprosma Baueri**, Endl., Iconogr. t. 111.—This plant is very common in New Zealand. I did not find it in Norfolk Island; it is probably rare.

48. **Coprosma lucida**, Forst., Char. Gen. 138.

Coprosma lucida, Forst., Endl., Prod. p. 60. "I am by no means clear that this plant is not distinct from Forster's plant which I gathered at New Zealand in 1826, in having broader emarginated leaves" (A. Cunn. MSS.).

Originally found by Bauer at Anson Bay.

49. **Coprosma pilosa**, Endl., Prod. Norf. 60.—This is sometimes called "Sharkwood" on the Island because "after rain the shrub smells like dead shark."

COMPOSITÆ.

50. **Vernonia cinerea**, Less.—New for the Island.

51. **Gnaphalium japonicum**, Thunb. (*G. involucratum*, Forst., Endl., Prod. Norf. 100: *G. lanatum*, Forst., Endl., Prod. Norf. 99).

52. **Gnaphalium luteo-album**, Linn., Endl., Prod. Norf. 98.

53. **Wedelia biflora**, DC. (*W. Forsteriana*, Endl., Prod. Norf. 102: *Buphthalmum uniflorum*, Forst., "Norfolciæ insula," Forst., Prod. No. 541, p. 91).

54. **Bidens pilosa**, Linn.—"Broom-Stick" of the Islanders. New for the Island.

55. **Cotula australis**, Hook. f.—New for the Island.

56. **Erechtites arguta**, DC. (*Senecio argutus*, Rich., Endl., Prod. Norf. 101).

57. **Senecio lautus**, Forst.—New for the Island.

58. **Sonchus oleraceus**, Linn.—New for the Island (Captain Cook recorded "Sow thistle").

59. **Picris hieracioides**, Linn.—New for the Island. I have expressed the opinion, and have given reasons, (Agric. Gazette, N.S.W., August, 1899) that this is indigenous to Australia, although Mueller held a different view.

CAMPANULACEÆ.

60. **Wahlenbergia gracilis**, A. DC.—New for the Island.

61. **Lobelia anceps**, Thunb., Prodr. Plant. Cap. 40, 1794. (Syn. *L. alata*, Labill., var. *stolonifera*, Endl., Prod. Norf. 97).

PRIMULACEÆ.

62. **Samolus repens**, Pers., Syn. i. 171. (Syn. *S. littoralis*, R.Br., Endl., Prod. Norf. 94).

MYRSINEÆ.

63. **Rapanea crassifolia**, Mey., Pflanzenreich, 9 Heft, iv. 236, p. 366. (*Myrsine crassifolia*, R.Br., Prod. 534; Endl., Prod. Norf. 95).—Known as "Beech" on the Island.

SAPOTACEÆ.

64. SIDEROXYLON COSTATUM, F.v.M., (non Endl., as in Tate's List). (*Achras costata*, Endl., Prod. Norf. 96).—Found by Allan Cunningham on Phillip Island. It is also found on the mainland. Mr. Robinson calls it "Bastard Ironwood," and also a "Sharkwood."

JASMINEÆ.

65. JASMINUM SIMPLICIFOLIUM, Forst. f., Prodr. 3. (Syn. *J. gracile*, Andr., Endl., Prod. Norf. 111).

"Among these is the Slender Jasmine, *Jasminum gracile*, known in England as a delicate green-house plant. Here it grows over the bushes, or with twisted stems, as thick as a man's wrist, reaches the branches of lofty trees, at fifty feet from the ground, and climbs in their heads. In these cases it has probably grown up with the trees, the lower branches of which have progressively died away, and left the wreathed stems of the Jasmine-like ropes hanging from the upper boughs" (Backhouse, 258).

66. OLEA APETALA, Vahl, Sym. Bot. iii. 3. (Syn. *Olea Endlicheri*, F.v.M., Journ. Bot. xxiii. 354, 1885, a name which Mueller in the following passage proposed to adopt for the Norfolk Island *Olea*.

"As regards the *Olea* from Norfolk Island, it might be now incidentally remarked that it should be distinguished as *Olea Endlicheri*, inasmuch as Vahl described in the *Symbolae*, iii. 3, his *Olea apetala* from New Zealand."

Tate has the name *Olea Endlicheri*, Britten, apparently a slip of the pen, through Mr. Britten being editor of the Journal of Botany. The species name cannot, of course, be changed simply because of a locality, otherwise one must change all the New Zealand species subsequently found in Norfolk Island. The Norfolk Island and New Zealand Oleas are quite identical. This was pointed out by Allan Cunningham (Lond. Journ. Bot. i. 116), and I also have proved their identity.

This is the "Ironwood" of the Island. The colour of the fruits varies a good deal, being golden-yellow, bright red and purple on the same and different trees.

A manuscript, circa 1848, says:—"Ironwood (*Notelea longifolia*) is used in all wheelwrights' work, and is very hard and durable; it is also used for cabinet-work, and, when French-polished, it is not excelled by any of the fancy woods."

It is the timber chiefly used for posts on the Island, its durability in such a situation being far more than any others. It is used for shafts of vehicles, which is testimony to its strength and toughness.

Prof. Tate (*op. cit.* p. 217) also gives *Olea paniculata*, R.Br., from Norfolk Island. This species occurs in New Caledonia, but without particulars of its collection I do not recommend that it be admitted into the flora of Norfolk Island.

APOCYNEÆ.

67. MELODINUS BAUERI, Endl., Prod. Norf. 113.—"Big Creeper."

68. ALYXIA GYNOPOGON, Roem. & Schult., Syst. Veg. iv. 440, 1819; F.v.M., Fragm. viii. 47. (Syn. *Alyxia daphnoides*, A. Cunn., Bot. Mag. t. 3313: also *A. Forsteri*, A. Cunn., Loud. Suppl, 580, *teste* Endlicher: *Gynopogon Alyxia*, Forst., Prod. p. 19, "foliis verticillatis quinis obovatis F. Norfolciæ insula." A. Cunn. (Heward), quotes Bot. Mag. t. 3313, and gives the habitat "dry shaded woods."

A. Gynopogon is known on the Island as "Box."

In figuring *A. daphnoides* in Bot. Mag. t. 3313, A. Cunningham says:—

> "From *A. Gynopogon*, however, which Forster first collected on that (Norfolk) Island, this second species differs in being altogether a shrub of a more robust and stiff habit, with rough tomentose branches and broader leaves, the latter of a uniformly thicker texture. . . . The stigma also is furnished at its summit with a little pencil-like tuft, whereas that of *A. Gynopogon* . . . is perfectly smooth."

I gave attention to the matter when on the Island, and agree with Mueller (Fragm. viii. 47) that they are not specifically different.

Ochrosia elliptica, Labill.—In early bud and therefore doubtful.

ASCLEPIADEÆ.

69. TYLOPHORA BIGLANDULOSA, A. Gray, Proc. Am. Acad. Sc., v. 1864; F.v.M. Fragm. ix. 169. (Syn. *Hybanthera biglandulosa*, Endl., Prod. Norf. 115).

T. enervia, F.v.M. The species hitherto only recorded from Lord Howe Island, but found by me in Norfolk Island also. There is great variation in the width of the leaves of this plant. I consulted Mr. Rudolph Schlechter, an authority on the *Asclepiadeæ*, who was recently in Sydney, and he is of opinion that the species is probably not different from *T. biglandulosa*. I could find only one species on the Island, and therefore recommend that *T. enervia* be not recognised as a separate species pending further enquiry.

GENTIANEÆ.

70. ERYTHRÆA AUSTRALIS, R. Br.—New for the Island.

BORAGINEÆ.

71. CYNOGLOSSUM AUSTRALE, R. Br., Prod. v. l. p. 495.—Near the settlement (A. Cunn. in Heward).

CONVOLVULACEÆ.

72. IPOMŒA BONA-NOX, Linn. (Syn. *I. ambigua*, Endl., Prod. Norf. 108; and *I. carinata*, Endl., Prod. Norf. 107).

> "*Ipomæa carinata*, a large plant of the Convolvulus tribe, having white flowers, with long tubes, that open at night, climbs among the trees, in the borders of the woods" (Backhouse, 268).

73. IPOMŒA CATARACTÆ, Endl., Prod. Norf. 106.—Its name was given because it was originally found at the Cascades.

> "Among the sugar-cane and scrub at this point, a beautiful convolvulus-like plant, *Ipomæa cataractæ*, is entwined, and exhibits its large purple flowers shot with red" (Backhouse, 268).

74. IPOMŒA CONGESTA, R. Br., Prod. 485.—Flowers of a brilliant carmine.

75. IPOMŒA PES-CAPRÆ, Roth.—New for the Island.

76. IPOMŒA PALMATA, Forskael, Fl. Aegypt. Arab. 48. (Syn. *I. pendula*, R. Br., Endl., Prod. Norf. 105).

> "One of the most beautiful climbers of the Island is *Ipomœa pendula*, which has handsome, fingered foliage, and flowers like those of the Major Convolvulus, but of a rosy pink, with a darker tube" (Backhouse, 258).

It is found all over the Island, climbing the highest trees.

77. CONVOLVULUS AFFINIS, Endl.,* (as *Calystegia*). (Syn. *Calystegia affinis*, Endl., Prod. Norf. 103.)—A small white runner.

78. CONVOLVULUS SOLDANELLA, Linn. (*Calystegia Soldanella*, A. Rich., Endl., Prod. Norf. 104).

79. CONVOLVULUS MARGINATUS, Spreng.—Recorded in B. Fl. iv. 430.

SOLANACEÆ.

80. SOLANUM BAUERIANUM, Endl., Prod. Norf. 109.—Bauer found it on Norfolk Island.

81. SOLANUM NIGRUM, Linn., Eng. Bot. t. 566.—Common everywhere (A. Cunn. in Heward). Found by him also on Phillip Island.

> "Eaten by the prisoners, who also collect and cook the berries of the 'Black Nightshade,' *Solanum nigrum*. These berries are accounted virulently poisonous in England, but their character may possibly be changed by the warmer climate of Norfolk Island" (Backhouse, 264).

They are often eaten in New South Wales, both raw and cooked. At the same time instances of their injurious character in Europe are well authenticated. It may be that plants grown in damp and dismal situations are injurious, while those grown in dry, sunny places are innocuous, but this is but surmise, as I have not been able to trace the relation of soil, &c., to deleterious properties so far.

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* I do not know whether this is breaking the golden rule of never making a man say what he did not say. Bentham's practice when he transferred a species to another genus, was to give the author of the species in the old genus as the author of the same species in the new. But that practice has not been followed in the case of the next species, perhaps because Linnæus and A. Richard described the species independently, and it was not merely a transfer of names.

82. S. AVICULARE, Forst., Prod. Ins. Aust. 107.—Recorded by A. Cunn., in Heward, as "*Solanum laciniatum*, Ait., Hort. Kew. v. 1, p. 247, Ed. 2, Bot. Mag. t. 319. Near the settlement."

SCROPHULARINEÆ.

83. VERONICA CALYCINA, R.Br.—New for the Island.

BIGNONIACEÆ.

84. TECOMA AUSTRALIS, R.Br. Syn. *Bignonia Pandoræ*, Gawl., the "Norfolk Island Trumpet-flower." See Bot. Mag. t. 865, where it is stated—

> "It is a native of Norfolk Island, in the South Seas, whence the seeds were brought to this country by Governor Patterson, from whose information it appears that a very destructive blight generally makes its first appearance upon the young shoots of this shrub, and spreads from thence over the whole vegetation of the Island; from this relation the name we have adopted derived its origin."

Perhaps, however, the name is a reminiscence of H.M.S. Pandora, which captured some of the mutineers of the Bounty.

MYOPORINEÆ.

85. MYOPORUM OBSCURUM, Endl., Prod. Norf. 110.—"Sandalwood" of the islanders. Found also by Allan Cunningham on Phillip Island.

VERBENACEÆ.

86. VERBENA OFFICINALIS, Linn.—New for the Island.

87. VITEX TRIFOLIATA, Linn. (*Vitex ovata*, Thunb., Fl. Jap. p. 257).—"A shrubby procumbent plant on the rocks and sands of the coast, flowering in December" (A. Cunn. in Heward).

I did not collect it. It is a common Polynesian plant.

NYCTAGINEÆ.

88. PISONIA BRUNONIANA, Endl., Prod. Norf. 88.—Called "Wai Wai" after the Tahitian name (meaning "watery"); also "Beech."

AMARANTACEÆ.

89. ACHYRANTHES ARBORESCENS, R.Br., Endl., Prod. Norf. 89.—A scrambling tree of 20 or 30 feet, with a stem diameter of 1 foot. Called "Softwood" by the islanders, and its timber is indeed about as hard as a tough turnip.

90. ACHYRANTHES ASPERA, Linn., Spec. Plant. 204, 1735; F.v.M., Fragm. ix. 169; B.Fl. v. 246. (Syn. *A. canescens*, R.Br., Endl., Prod. Norf. 90: *A. aspera*, Linn. var. *canescens*.)—Same as the Lord Howe Island plant.

POLYGONACEÆ.

91. RUMEX BROWNII, Campd.—New for the Island.

92. MUEHLENBECKIA AUSTRALIS, Meissn., Gen. Comm. 227. (Syn. *Polygonum australe*, A. Rich., Endl., Prod. Norf. 86: *Coccoloba australis*.)—Called "Shrubby Creeper" by some people on the Island. Recorded by Allan Cunningham from Phillip Island also.

PIPERACEÆ.

93. PIPER EXCELSUM, Forst., Prod. No. 20.—"Ins. Norfolk, Cunningham! in h. Kew." C. De Candolle in DC. Prod. xvi. (1), p. 335: "*P. psittacorum*, foliis majoribus 0·12 longis. In ins. Norfolk (Cunningham! Hügel! Endlicher! in h. Vindob.): *Macropiper psittacorum*, Endlich.! prod. Norfolk, p. 37, Bauer pl. Norf. t. 37, fide Endlich. l.c. (C. De Candolle, *loc. cit.*)."

It would thus appear that the typical form, as well as a variety, occurs on Norfolk Island. The variety has been recorded by Allan Cunningham from Phillip Island.

"The Norfolk Island Pepper, *Piper psittacorum*, which produces a yellow, pulpy, pendent, cylindrical fruit, of a spicy, sweetish taste, is everywhere plentiful in the woods. It rises with a few, jointed, cane-like, green stems, to from four to ten feet high, bearing large, heart-shaped leaves" (Backhouse, p. 271).

A manuscript states :—

"The Norfolk Island Spice (*Piper psittacorum*) attains the height of 10 feet, and has heart-shaped leaves; it produces a cylindrical fruit of a spicy, sweetish taste, which is an excellent preserve, and if gathered green it is equally good pickled. The leaf bears great resemblance to that of the Pan or betle-creeper of the East Indies."

94. **Peperomia reflexa**, A. Dietr., Spec. Pl. i. 180, var. *æmula*, C. DC.—"Foliis ut in precedente (var. *capensis*) pedunculo hirtello folia æquante. In ins. Norfolk (Bauer! in S. Endl. et in h. Berol. Cunningham! in h. Kew.). *Piper æmulum*, Endl., prod. flor. Norf. p. 36. Bauer ill. Norf. ined. p. 127, fide Endl. l.c. *Peperomia reflexa*, forma Norfolcensis, Miq. Syst. ! p. 172" (C. De Candolle in DC., Prod. xvi. (1), 451).

95. **Peperomia Urvilliana**, A. Rich. (*loc. cit. infra*). Syn. *Peperomia Endlicheri*, Miq., Syst. Pip.* 102.—"In insulis Norfolk (Cunningh.! in h. Kew et Endlich. ! in h. Berol. MacGillivray n. 971 ! in h. Kew).

Syn. *Piper simplex*, Endl., ! Prod. Norf. p. 37. Bauer ill. Norf. t. 12a (teste Endl. l.c.). *Peperomia Urvilliana*, A. Rich. in d'Urv. Voy. Astrolab. p. 356 (C. De Candolle in DC. Prod. xvi. (1), 413). C. DC. gives *P. Endlicheri*, Miq., as the name. *P. Urvilleana*, A. Rich. (1832), is the name adopted by Mueller in Census, and has undoubted priority. The "e" is, however, incorrect.

96. **Peperomia Baueriana**, Miq., Syst. 120.—"In ins. Norfolk (Bauer ! in h. Endl., Endl. ! in h. Berol. Cunningham in h. Kew). *Piper adscendens*, Endl. ! prodr. Norf. p. 36" (C. DC. in DC. Prod. xvi. (1), 414).

97. **Peperomia leptostachya**, Hook. et Arn., in Beech. Bot. p. 96. Recorded by Tate (*op. cit.* p. 217), but I do not know the name of the collector.

THYMELEACEÆ.

98. **Wickstrœmia australis**, Endl., Prod. Norf. 93.—Known as "Kurrajong." Its bark is the common tying material of the Island. It attains a height of 20 feet. Perhaps it is referred to in the following passage:—

> "I was told this day that one of the convicts had found out the bark of a tree fit for making lines or rope. On examining it I found it, as far as I can

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* Miquel (F. A. W.), Systema Piperacearum. Roterodami, 1843-4, 8°: also Illustrationes Piperacearum (Vratislaviæ, 1844) 4°.

at present judge, very proper for the purpose of making lines, ropes or cloths. It in many respects answers the description given of the Chinese mulberry paper by Captain Cook of which the inhabitants of Otaheite make their cloths. On trial we found this bark would answer every temporary purpose of tying, but as it very soon rots when exposed to the weather it will not answer to be worked " (Lieut.-Govr. King—31/3/1789—in Hist. Rec. N.S.W. Vol. ii., p. 617).

LORANTHACEÆ.

99. VISCUM ARTICULATUM, Burm. f., Fl. Ind. 311. (*Viscum distichum*, Endl., Prod. Norf. 119).

The joints are as much as 1½ in. across. It is very abundant on the Island, being very common on *Baloghia lucida*, the Bloodwood. The only other native tree on which I observed it is *Xanthoxylon Blackburnia*, but further search should be made. As regards introduced plants, it is common on Lemons and kills Peach trees. In fact it is a pest in orchards.

SANTALACEÆ.

100. EXOCARPUS PHYLLANTHOIDES, Endl., Prod. Norf. 91.

A manuscript in my possession states :—" The Cherry-tree, the bark of which is used in tanning, is one of the most useful woods and is decreasing rapidly by being stripped of its bark and so left to perish."

Downing states, " The Cherry-tree, a species of *Exocarpus*; the bark of the latter rich in tannin, has been used for leather-making."

The islanders now call it " Isaac Wood," after Isaac Quintal, from Pitcairn, who first pointed it out.

We therefore have an instance of two sets of vernaculars, the Pre-Pitcairn and the Pitcairn.

The largest tree I saw was 30 feet high and with a diameter of 1 foot, in the north-west part of the Island, near Mr. Kendall's.

EUPHORBIACEÆ.

101. EUPHORBIA OBLIQUA, Endl., Prod. Norf. 144.

" The rocky shore of this Island is accessible from the land, in some places, on the south-west. In a few of the valleys, near the sea, in this direction, *Euphorbia obliqua*, a remarkable shrub, forms copses, attaining, when shaded by trees, to 15 feet in height, and 2 feet in circumference" (Backhouse, 270).

I did not come across it. It has probably been much destroyed.

102. E. GLAUCA, Forst., Prod. 208; Endl., Prod. Norf. 145. See also Hook., Hdbk. Fl.N.Z. p. 248.

A neat shrub found by Mr. Boorman and myself on the beach at Ball's Bay. The leaves somewhat resemble those of an Oleander.

103. EUPHORBIA NORFOLKIANA, Boissier in DC., Prod. xv. 110.

"In insula Norfolk (Backhouse! A. Cunn. in h. Kew. F. Bauer in h. Vindob.!). *Euphorbia tannensis*, Spreng., Syst. iii. 791.

An erect plant synonymous with *Croton elutioides*, Forst., is stated by Boissier to occur on Norfolk Island. There is in Forst. Prod. 521 a "Euphorbia Norfolciæ insula."

Prof. Tate (*op. cit.* p. 217) says that *E. Norfolkiana* and *E. tannensis* are identical. I do not know on what authority. I did not collect the plant.

104. E. SPARMANNI, Boissier.—First recorded from the Island by Tate. I collected it also.

105. BALOGHIA LUCIDA, Endl., Prod. Norf. 143.

A manuscript says :—

> "The Bloodwood (*Croton sanguisfluia*) is of little value except for firewood, but on an incision being made in the bark, a fluid exudes which is used for staining furniture, marking the convicts' slops, etc., and it is a good tonic and astringent.

Allan Cunningham recorded this tree also from Phillip Island. It is the commonest tree for *Viscum*. The sap has been used as medicine as an astringent.

106. EXÆCARIA AGALLOCHA, Linn., Endl., Prod. Norf. 142.

I heard this small tree called "Sapota" by a resident.

I do not doubt that this is the plant referred to by Hunter (p. 311) in the following passage :—

> ". . . the workmen indeed had been often blinded for four or five days together by the white sap of a tree, which getting into their eyes, caused a most excruciating pain for several days. . . . One man was totally blinded with it for want of making timely application to the surgeon."

URTICACEÆ.

107. **Malaisia tortuosa**, Blanco.—Found in Lord Howe Island. Tate records it from Norfolk Island.

108. **Celtis paniculata**, Planch. (Syn. *Solenostigma paniculatum*, Endl., Prod. Norf. 42).—The "Whitewood" of the Island.

109. **Pseudomorus Brunoniana**, Bureau, var. **pendulina**. (Syn. *Morus pendulina*, F. Bauer, in Endl., Prod. Norf. 40).—The "Isaac Wood" of some people. See *Exocarpus* (*supra*, p.715). But its most general name is "Siah's backbone" (Josiah's backbone, after Josiah Adams), in allusion to the pliability and toughness of its wood.

110. **Procris montana**, Steud. (Syn. *Elatostemma montanum*, Endl., Prod. Norf. 39).

111. **Boehmeria australis**, Endl., Prod. Norf. 38.

112. **Parietaria debilis**, Forst. f., Prod. 73. (Syn. *Urtica debilis*, Endl., Prod. Norf. 37).

b. Monocotyledonæ.

ORCHIDEÆ.

113. **Oberonia Titania**, Lindl., Fol. Orch. Ober. 8 (Syn. *Titania miniata*, Endl., Prod. Norf. 31).—From Anson Bay.

114. **Oberonia palmicola**, F.v.M.—On the bark of trees. New for the Island.

115. **Dendrobium brachypus**, Reichb. f., Linnæa xli., 42, 1877. (Syn. *Thelychiton brachypus*, Endl., Prod. Norf. 32).—Rare.

116. **Dendrobium macropus**, Benth. & Hook., Gen. Pl. iii. 500. (Syn. *Thelychiton macropus*, Endl., Prod. Norf. 32).—Common on Pines (*Araucaria*) and other trees.

117. **Bulbophyllum argyropus**, Reichb. f., Linnæa, xli., 42, 1877. (Syn. *Thelychiton argyropus*, Endl., Prod. Norf. 32).—Originally recorded from Anson Bay.

Bulbophyllum (sp. aff. to *B. exiguum*, F.v.M.).

118. **Phreatia limenophylax**, Reichb. f., Bonplandia, 1857, 54 (partly); B.Fl. vi. 290. (Syn. *Plexaure limenophylax*, Endl.,

Prod. Norf. 70).—On the bark of trees. A small plant originally recorded from Anson Bay.

119. MICROTIS PORRIFOLIA, R.Br.—The only terrestrial orchid. Apparently new for the Island. Common at Bullock's hut.

AMARYLLIDEÆ.

120. CRINUM NORFOLKIANUM, A. Cunn.

"A. Cunn. MSS. (*sp.nov.*) *foliis margine lævibus, pedicellis ovario parum* longioribus, staminibus laciniis lanceolatis dimidio brevioribus, filamentis anthera 5- 6-ies longioribus. In wet ground, Mill or Arthur's Vale. This species is near *C. pedunculatum*, R.Br., but certainly distinct" (A. Cunn. in Heward).

It is in this locality to this day.

LILIACEÆ.

Smilax purpurata, G. Forst., Prod. 373.—"Sarsaparilla." I believe I have this on good authority, but I cannot quote it.

Smilax glycyphylla, Sm.—In Tate's List. I doubt it.

121. RHIPOGONUM DUBIUM, Endl., Prod. Norf. 69.

122. GEITONOPLESIUM CYMOSUM, A. Cunn., Endl., Prod. Norf. 68.

There has been considerable confusion with the synonymy of the *Cordylines*, as will appear from the following:—

123. CORDYLINE OBTECTA, J. G. Baker, Journ. Linn. Soc. Bot. xiv., 543. (Syn. *Cordyline Baueri*, Hook. f., Gard. Chron. 1860, 792; Mueller, Second Census, 197).

Cordyline australis, Endl., Prod. Norf. 29 (Bauer, Ill. 176-7, 207 and Regel, Gartenfl. t. 450, according to J. G. Baker).

The name *Cordyline nutans*, A. Cunn., under which it commonly occurs in Australian gardens, should apparently be *Cordyline nutans*, Hort.

Dracæna obtecta, Graham, Edin. Phil. Journ. 1827, 175; *Dracæna australis*, Hook., Bot. Mag. t. 2835, non Forster; *Dracæna nutans*, A. Cunn. MSS.

Not only has there been much confusion in regard to the synonymy of this species, but also in regard to its native country.

Mr. J. G. Baker, who first cleared up the matter,* correctly gives the locality "Insula Norfolk (sed non Nova Zelandia nec Nova Hollandia ut auctores dicunt)."

The Islanders call it "Rau-ti" or Palm, this being the usual name for a *Dracæna*.

". . . . a Norfolk Island Bread-fruit, *Cordyline australis*, 2 feet 9 inches. The last sometimes attains 20 feet in height (I have seen it higher. —J.H.M.); it branches from within a few feet of the ground, and forms several heads, with flag-like leaves, and long, branched spikes of greenish, star flowers, succeeded by whitish, or bluish-purple berries, that are eaten by parrots. It often forms a striking object, where a woody valley runs out into grass, growing at the extreme margin of the wood" (Backhouse, 271).

In a manuscript in my possession, and also in Downing (*op. cit.*), it is referred to as *Charlwoodia*† *australis*.

124. CORDYLINE TERMINALIS, Kunth, var. *cannæfolia*, J. G. Baker, *op. cit.*, p. 541 : *C. cannæfolia*, R.Br.

"*Cordyline cannæfolia*, R.Br., Prod. v. l., p. 280. On the dry grassy sides of the hills immediately above the military officers' gardens" (A. Cunn. in Heward).

On Norfolk Island it is known as the "Pitcairn or Home Rau-ti" ("home" being the word for Pitcairn amongst the Pitcairn Islanders and their descendants).

According to Allan Cunningham it was apparently not scarce on the Island in 1830. Although I made careful search, I found only one plant of it (it certainly is rare), and that was in a garden at Steel's Point. I was distinctly told that the Pitcairners brought this plant to Norfolk Island, and my informant reminded me that the sweet root was formerly used in Pitcairn to prepare an ardent spirit. In the face of Cunningham's statement I, of course, admit it as a Norfolk Island indigene, but it would appear to have been exterminated, perhaps because the convicts turned it into a curse, as the Pitcairners did at an early period of their history. The Pitcairners brought this plant to Norfolk Island in a box, as indeed they did many others, and I believe my informant is quite correct in this respect, as his wife is a native of Pitcairn, and the circumstances are quite clear to him.

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* "Revision of the Genera and Species of Asparagaceæ." Journ. Linn. Soc. Bot. xiv. 543.

† Sweet's *Charlwoodia*; see his Flora Australasica, t. 18. His *Charlwoodia congesta*, figured there, is our *Cordyline stricta*, Endl.

125. PHORMIUM TENAX, Forst., Endl., Prod.Norf. 65.

This, next to the *Araucaria excelsa*, useful for spars, is the plant considered by Governor Phillip and the Home authorities to be the most important economic plant on Norfolk Island, as the provision of cordage for H.M. Navy was a most important matter.

Following are Lieut.-Govr. King's instructions in regard to this plant:—

"You are immediately to proceed to the cultivation of the flax-plant, which you will find growing spontaneously on the Island." (Hist. Rec. N.S.W. Vol. i. pt. 2, 130).

King replied (*ib.* 126) that the cultivation would be attended to when people could be sent to clear the ground.

"We found our road must be down ye hill, which is perpendicular and quite full of a large kind of iris, which was a providential circumstance for us, as they served us to hold by when we were all falling, and had they not presented themselves, we must have fell down a depth of 90 feet." (Lieut.-Govr. King, in March, 1788, in Hist. Rec. N.S.W. Vol. ii. p. 552.)

Its natural habitat on the Island is the sides of steep banks or cliffs. Under date 17th of the same month (they had only just arrived on the Island), he states, (*ib.* p. 557):—

"This day I discovered that ye flax-plant, which Capt. Cook takes notice of, is no other than that plant which I have hitherto called ye larger kind of iris, with which ye Isle abounds, but it in no manner resembles ye flax of Europe, its appearance being more like flags. A bundle of it was tied up and put into a pool of water to soak intending to try it after ye European method of preparing ye flax."

Following was the first attempt to manufacture it:—

"On the 29th I found that 30 bundles of flax, put into soak in October, was sufficiently rotted to pass it thro' the hackle; broke off 4 men to clean it. . . . I mean to let it stay 3 days longer in the water, and to make the women wash it in running water, and afterwards dry it, and then pass it thro' the hackles" (*Ib.*, p. 261).

The Lieut.-Govr. introduced two New Zealanders to teach the prisoners how to extract the fibre from the flax, but their process was found to be so tedious that it was abandoned.

126. DIANELLA INTERMEDIA, Endl., Prod. Norf. 66.—Recorded from Anson Bay.

COMMELYNACEÆ.

127. COMMELYNA CYANEA, R.Br. Prod. v. 1, 269.—Recorded by A. Cunningham from "near the settlement." Known as "Forget-me-not" by the Islanders. Found also by him on Phillip Island.

PALMÆ.

128. RHOPHALOSTYLIS BAUERI, H. Wendl. and Drude, Bot. Zeit. xxxv. (1877) 63. (Syn. *Kentia Baueri*, Seem., Fl. Vit. 269: *Areca sapida*, Endl., Prod. Norf. 64, non Solander ex Forst.).

Hooker (Hbk. N.Z. Fl., 288) points out that *sapida* and *Baueri* are closely allied, but that the latter is a larger plant. While this plant is supposed to be peculiar to Norfolk Island and Chatham Island (N.Z.), Mr. I. Robinson informs me that it also occurs on Sunday Island, in the same latitude, a statement that might be borne in mind by any botanist or collector visiting the latter Island.

The Norfolk Islanders call this palm "Nikau," which is the New Zealand name for *R. sapida*, and which has probably been borrowed from New Zealand.

The midribs are used for brooms, and there is some illicit felling of the palms for this purpose, which should be prohibited. The following interesting account of the palm is by Backhouse; and here I may mention that Backhouse's descriptions of the flora, usually entirely accurate, are particularly valuable inasmuch as the vegetation has been so much interfered with since his day:—

"In the woody gullies the Norfolk Island Cabbage-tree, *Areca sapida*, abounds. It is a handsome palm, with a trunk about twenty feet in height, and from one and a half to two feet in circumference, green and smooth, with annular scars, left by the fallen leaves. The leaves or fronds form a princely crest at the top of this elegant column; they are pectinate, or formed like a feather, and are sometimes nineteen feet in length; they vary from nine to fifteen in number. The apex of the trunk is enclosed in the sheathing bases of the leaf-stalks, along with the flower buds, and young leaves. When the leaves fall they discover double compressed sheaths, pointed at the upper extremity, which split open indiscriminately, on the upper or under side, and fall off, leaving a branched spadix, or flower-stem, which is the colour of ivory, and attached by a broad base to the trunk. The flowers are produced upon this spadix; they are very small, and are succeeded by round seeds, red externally, but white, and as hard as horn, internally. As the seeds advance towards maturity, the spadix becomes green. The young, unfolded leaves of the Cabbage-tree, rise perpendicularly, in the centre of the crest. In this state they are used for making brooms; those still unprotruded and remaining enclosed within the sheaths of the older leaves, form a white mass, as thick as a man's arm; they are eaten raw, boiled, or pickled. In a raw state, they taste like a nut, and boiled they resemble artichoke bottoms. The seeds furnish food for the Wood-quest, a large species of pigeon" (Backhouse, 264).

PANDANEÆ.

Pandanus Moorei, F.v.M., in Tate's List.—There is no *Pandanus* on the Island, and the mistake has probably arisen through assuming that the name "Screw Pine," freely used, refers to a *Pandanus*. *P. Moorei*, F.v.M., recorded originally from Lord Howe Island, has no separate existence. I have dealt with the matter at some length—these Proceedings, 1898, p. 141.

129. Freycinetia Baueriana, Endl., Prod. Norf. 63.—"Screw Pine" of the islanders; called also "Palm" and "Palm Lily." Following is Backhouse's account of this plant. The base of the fructification is eaten and is described to me as tasting like a banana.

"One of the remarkable vegetable productions of this island is *Freycinetia Baueriana*, or the N. I. Grass Tree. . . . Its stem is marked by rings, where the old leaves have fallen off, and is an inch and a half in diameter; it lies on the ground, or climbs like ivy, or winds round the trunks of trees. The branches are crowned with crests of broad, sedge-like leaves. From the centre of these arise clusters of three or four oblong, red, pulpy fruit, four inches in length, and as much in circumference. When the plant is in flower the centre leaves are scarlet, giving a splendid appearance to the plant, which sometimes is seen twining round the trunk of the princely Tree-fern" (Backhouse, 256).

TYPHACEÆ.

130. TYPHA ANGUSTIFOLIA, Linn., var. BROWNII, Kronfeld, Verh. Zool.-Bot. Ges. Wien, xxxix. 152 (1889). (Syn. *T. latifolia*, Forst., Prod. 64 ; *T. angustifolia*, R.Br., P. Graebner, Typhaceæ (Das Pflanzenreich, p. 13.)—"Swampy ground, Arthur's Vale" (A. Cunn.). It still occurs in the same place.

AROIDEÆ.

I was informed that there is an edible and a non-edible ("bastard") Taro on the Island. I presume the latter refers to *Colocasia macrorrhiza*, which is a likely inhabitant, though I did not notice it.

131. COLOCASIA ANTIQUORUM, Schott.—"Taro." I do not doubt that the following extracts refer to this species. I saw it abundantly present at the place indicated by Lieut.-Govr. King in 1788. I quote the passage, as it is very important to arrive at precision in regard to the indigenous vegetation, especially where, as in the case of Norfolk Island, such vegetation has been so much interfered with :—

> "On ye 27th I discovered a great quantity of plantane trees,* which grow close to the stream of fresh water which runs through the valley, which is in this part of it dry, and not swampy as it is opposite the hill on which the settlement is and below it. The valley is also very wide and bordered by some small hills, which are as thickly covered with wood as any other part of ye island. . . . The plantane trees grow close to the water, and are so thick that they choak each other, besides the very great quantity of other small aquatic shrubs, and the bear-bind with which they are interlaced must necessarily retard their perfection. I, therefore, as soon as a man can be spared, intend clearing a spot round them, and transplanting some of ye suckers into dryer ground" (Lieut.-Govr. King, 27th April, 1788, Hist. Rec. of N.S.W., Vol. ii., p. 566).

And again, under date 16th May, 1788 :—

> "Broke two men off from clearing away on the N.E. side of ye hill to assist Mr. Altree in removing his things to the plantane plantation, where I

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* Plantain does not here refer to a *Musa*. The use of the word "tree" amongst old writers in the sense of "plant" is common enough. We still use the term "rose-tree" frequently. Vide *Musa*, infra, p. 754.

have ordered him to reside, in order to take care of those trees, and cultivate the adjoining grounds which may be cleared away in a short time" (*Op. cit.*, p. 570).

And on 3rd June :—

"Twelve plantane suckers were transplanted from ye rivulet into the plantation. I also sent there the banana trees as well as the lime* trees which I brought with me, not doubting but they will thrive" (*Op. cit.*, p. 575).

See also Hunter (pp. 306 and 308), founded on King's notes :— ". . . there is a fine valley in which a number of plantain or banana trees were found on the 5th" (April, 1788); and Order No. viii. (for the Good Government of the Island, promulgated at the same time) :—"No person is to cut down or destroy any banana tree." The colony was then but a few weeks old, and I think that King was mistaken in referring the plants to the Plantain or Banana (*Musa*).

CYPERACEÆ.

132. CYPERUS HÆMATODES, Endl., Prod. Norf. 59.—Used for basket-making. Some of the women make very neat baskets from the leaves.

Cyperus lucidus, R.Br.—I have a note of this name, but no specimens. The matter should be further enquired into.

133. C. ROTUNDUS, Linn.—New for the Island. Perhaps an introduction.

134. C. CONGESTUS, Vahl.—New for the Island.

135. KYLLINGIA MONOCEPHALA, Rottb.—New for the Island.

136. HELEOCHARIS ACUTA, R.Br.—Very variable in size and robustness. New for the Island.

137. SCIRPUS NODOSUS, Rottb. (*Ficinia guttata*, Endl., Prod. Norf. 61).—Six to 8 feet high.

138. SCIRPUS INUNDATUS, Spreng. (*Isolepsis conspersa*, Nees, Endl., Prod. Norf. 60).

139. SCIRPUS LACUSTRIS, Linn.—New for the Island.

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* *Citrus*, not *Tilia*.

140. S. RIPARIUS, Spreng.—New for the Island.

141. SCIRPUS MARITIMUS, Linn.—I obtained this at the Water Mill Dam and other places. Dr. Metcalfe informs me that it was originally collected by his son, and that the late Prof. Kirk of Wellington, N.Z., named it, but I cannot find any record of publication.

142. CAREX NEESIANA, Endl., Prod. Norf. 62.

143. CAREX INVERSA, R.Br.—New for the Island.

GRAMINEÆ.

> "There are, likewise, great plenty of cabbage trees, but not a single blade of grass has been seen on the island, the pigeons, sheep, and goats eating the leaves of the shrubs and of particular trees, with which they grow very fat." (Governor Phillip [Sept., 1788], doubtless based on Lieut. Govr. King's Report, Hist. Rec. N.S.W., Vol. i., Pt. 2, p. 187.)

It is not easy to understand the statement as to "not a single blade of grass." The trees and shrubs were very much more abundant than at present, but the Island had at that time been imperfectly explored, and is to be taken simply as a general statement. Perhaps there had been a partial drought. Following appear to be the indigenous species :—

144. PANICUM NORFOLKIANUM, Nees, Endl., Prod. Norf. 52.

145. P. EFFUSUM, R.Br.

146. P. CRUS-GALLI, Linn., Endl., Prod. Norf. 51.

147. P. SANGUINALE, Linn., var. CILIATUM (*P. ciliare*, Retz.).

148. PASPALUM SCROBICULATUM, Linn.

149. OPLISMENUS COMPOSITUS, Beauv., Endl., Prod. Norf. 54.—Forming dense mats in the forests.

150. O. UNDULATIFOLIUS, Beauv. (Syn. *O. æmulus*, Kunth, Endl., Prod. Norf. 53, and *O. setarius*, R. et Sch.)

151. ANDROPOGON REFRACTUS, R.Br.

152. A. AFFINIS, R.Br.—A very faint pit on the outer glume.

153. MICROLÆNA STIPOIDES, R.Br.

154. ECHINOPOGON OVATUS, Beauv.

155. SPOROBOLUS INDICUS, R.Br.—Recorded by Tate.

156. DEYEUXIA FORSTERI, Kunth. (*Agrostis Forsteri*, Roem. et Schult. : *A. Solandri*, F.v.M., a name against which Bentham, B.Fl. vii. 579, protests).

157. DICHELACHNE SCIUREA, Hook. f. (*D. montana*, Endl., Prod. Norf. 56).

158. DICHELACHNE CRINITA, Hook. f.

See B.Fl. vii. 575, where it would appear that there is some doubt as to the identification of *D. montana* with *sciurea*. If they are identical, then Endlicher's, or an earlier name of Kunth's, must stand.

159. CYNODON DACTYLON, Linn.—Everywhere.

160. AGROPYRON SCABRUM, Beauv. (*Triticum scabrum*, R.Br., Endl., Prod. Norf. 57).

161. TRITICUM KINGIANUM, Endl., Prod. Norf. 58.—Found in Phillip Island.

Of the above, Nos. 145, 147, 148, 151, 152, 153, 154, 156, 158, and 159 appear to be new records for the Island.

ii. GYMNOSPERMÆ.

CONIFERÆ.

1. ARAUCARIA EXCELSA, R.Br., Endl., Prod. Norf. 76 (*Cupressus columnaris*, Forst.*).

For list of synonyms, see Endlicher; also Hooker in London Journ. Bot. ii. 500 (1843), which contains a useful account of the tree.

This tree was originally observed by Cook (*op. cit.*) when he discovered the island; in fact no one, even now, can fail to see it, either from sea or land.

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* *Cupressus columnaris*, Forst., Prod. 351 :—"Foliis imbricatis subulatis sulcatis, strobilis cylindricis elongatis, F. Nova Caledonia et Norfolkciæ insula."

As regards its size, the reports of the early residents are important, particularly as they were mostly taken from actual measurements of felled trees.

Lieut.-Govr. King wrote in March, 1788 :—

"The pines, which are very numerous, are of an incredible growth, one of them which had been blown down or fell by age measured 140 feet, and several others which we measured were 27 feet in circumference; they grow quite straight, and not an exuberance of any kind whatever on them from ye top to the bottom" (Hist. Rec. N.S.W., Vol. ii., p. 551).

Under date 17th March he wrote :—

"Felled a pine near it to saw into planks and scantling; its length is 115 feet and 2 ft. 3 in. diameter about breast high." . . . "I believe the wood is nearly as light as the best Norway masts, and grows to a most extraordinary size, some of the trees measuring from one hundred and sixty to one hundred and eighty feet without a branch" (*Ib.*, p. 551).

"The remains of two Pines, which were noted for their magnitude, and were blown down in a storm, were lying by the side of the road. These were called 'The Sisters'; they were nearly 200 feet in height" (Backhouse, 258).

"On the northern ascent of Mt. Pitt a pine was measured 29½ feet in circumference at 4 feet up" (Backhouse, 271).

"We measured a Norfolk Island pine, twenty-three feet, and another twenty-seven feet, in circumference. Some of them are nearly two hundred feet high" (*Ib.* p. 264).

Dr. Metcalfe informs me that the largest tree he has measured or heard of had a girth of 37 feet.

The following notes from Backhouse's botanical MSS. are quoted by Hooker :—

"This stately tree is similar in figure to the Norway Spruce; but its branches are in more distant whorls, and usually about five in a whorl. The young lateral branchlets are deciduous, or, at least, they fall off in great numbers. The two lips of the scales of the cone become united and form a ligneous covering to the seeds; external to this is a fleshy, terebinthaceous coat, containing a milky resinous juice; the cone resembles a globular pine apple in form, and has the scales deciduous. Large quantities of resin, like frankincense, are exuded from incisions in the bark. The timber is useful for inside work, but soon perishes when exposed to the weather, especially as posts in the ground. The knots* formed by the larger limbs of old trees which lose in some measure their regularity of form, are close-grained, and afford handsome material for turning and inlaying" (London Journ. of Bot., ii. 500-501 (1848).

Backhouse went on to say that the grubs of the pine afforded food on Norfolk, Phillip and Nepean Islands to the now extinct parrot with long mandibles (*Nestor*).

A manuscript in my possession says :—

> "The Norfolk Island Pine (*Altingia excelsa*) is seen 100 feet above the other forest trees, and resembles the Norway Spruce, but its tiers are more distant. Fences made of this timber seldom stand 3 years. It is generally used for building purposes, flooring, partitions, etc.; and when kept dry and not exposed to the weather, it is more durable. The Pine (*Araucaria excelsa*) is also used for the same purposes, and is of precisely the same quality, but not so lofty as the former."

This alleges that there are two kinds of Pines on the Island. That there are two kinds is believed by a number of people in Australia also, but I could obtain no evidence of a second Pine —not even a slight variety of the normal species.

This *Araucaria* bears seeds usually every third year, and there is considerable commerce in them. Although Pines have been recklessly cut down for settlement, and for other reasons, they are abundant still; yet the Islanders have found it necessary to prohibit the felling of them on unalienated land except under close restrictions. The Pine is still planted a little on the Island, but the most notable instance is that of the noble avenue from Longridge to the Melanesian Mission and Orange Vale planted about 80 years ago. It is 1¼ miles long. Although I saw pines perhaps taller than those of the same species in the Botanic Gardens, Sydney, yet I saw none so large and symmetrical as the latter.

This timber is the one alone used for shingles on the Island. Heart shingles last 20 years, and ordinary ones from 10 to 12 years.

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*These pine knots were used by Mr. M. V. Murphy, Government Surveyor, for pegs, whenever available. Collins (2nd ed. p. 125) speaks of the people using the knots of the pine tree, "split and made into small bundles, as torches."

B. CRYPTOGAMÆ.

i. PTERIDOPHYTA.

a. Filicinæ.

The classification of the ferns is still in a somewhat unsettled condition. In the following pages, I have followed, as far as I could, the arrangement that Mr. Betche and I propose to follow in our forthcoming Census of the Plants of New South Wales.

I have drawn attention to some points that require clearing up. In some cases, in translating names to their now accepted equivalents, it has occurred to me that the finds require confirmation.

HYMENOPHYLLACEÆ.

1. **Hymenophyllum multifidum**, Swartz.—The ubiquitous *H. tunbridgense* does not appear to have been found on the Island.

2. **Trichomanes apiifolium**, Presl. (*T. Bauerianum*, Endl., Prod. Norf. 50).

"The Peperomias grow also on moist rocks, on the dark sides of which *Trichomanes Bauerianum*, a membranaceous fern, of great beauty, forms tufts exceeding a foot in height" (Backhouse, 267).

3. **Trichomanes humile**, Forst., Endl., Prod. Norf. 49.

POLYPODIACEÆ.

4. **Vittaria elongata**, Swartz (*V. rigida*, Kaulf., Endl., Prod. Norf. 35.—On tree-fern stumps; is possibly a variety of the type).

5. **Polypodium tenellum**, Forst. (*Arthropteris tenella*, J. Sm.: *P. tenellum* in Endl., Prod. Norf. 18).

Diels (Pflanzenfamilien) separates *Arthropteris* from *Polypodium* on account of the articulate pinnæ.

6. **Polypodium serpens**, Forst. (*Niphobolus rupestris*, Kaulf.: *N. serpens*, Endl., Prod. Norf. 21).

Niphobolus serpens, Endl., seems to be synonymous with *Polypodium serpens*, Forst., though *Niphobolus rupestris* is the only

Niphobolus given as synonymous by Hooker & Baker and Bentham.*

"*Niphobolus serpens* and *Polypodium tenellum*, two climbing ferns, ascend the trunks of the trees, in the northern portion of the Island" (Backhouse, 271).

7. POLYPODIUM CONFLUENS, R.Br., B.Fl. vii. (*P. glabrum*, Mett., Christ; *P. acrostichoides*, Sieb., non Forst.: *Niphobolus confluens*, R.Br., Nat. Pfl. Fam.).

Apparently not previously recorded from the Island, unless the following, which I cannot find in any list of synonyms, is the fern in question:—

"*Drymoglossum carnosum*, J. Sm., Journ. Bot. v. 4, p. 66. *Niphobolus carnosus*, Blume, Fl. Jav. t. 19? On rocks" (A. Cunn., in Heward).

8. POLYPODIUM ACROSTICHOIDES, Forst. (*Niphobolus acrostichoides*, Bedd.)—Recorded by Mueller in Carne's List.

9. POLYPODIUM PUSTULATUM, Forst. (Syn. *P. Billardieri*, R.Br., Endl., Prod. Norf. 19: *P. scandens*, Forst.).

Hooker & Baker (in Synops. Filic.) give *P. pustulatum*, Forst., and *P. Billiardieri*, R.Br., as distinct species; while Bentham (B.Fl. vii.) and Christ unite them. *P. scandens*, Forst., is *P. pustulatum*, Forst., according to Christ (Farnkräuter der Erde).

Our herbarium material from Norfolk Island consists of only one species, viz., *P. pustulatum*, Forst.

10. POLYPODIUM PHYMATODES, Linn.

"*Polypodium phymatodes*, *Drynaria vulgare*, J. Sm., Journ. Bot. v. 4, p. 61; Linn., Mant. p. 306; Schk. Crypt. t. 9. On decayed timber in damp woods" (A. Cunn., in Heward).

11. PHEGOPTERIS PUNCTATA, (Thunb.) Bedd. (*Polypodium rugosulum*, Labill., Endl., Prod. Norf. 20: *Polypodium punctatum*, Thunb., B.Fl. vii. 764: *Nephrodium punctatum*, Diels ?).—Both Christ and Diels separate *Polypodium punctatum* from *Polypodium* on account of the totally different habit and vena

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* Diels (Pflanzenfamilien) separates *Niphobolus* from *Polypodium*. Bentham, Hooker, Baker and Christ unite it with *Polypodium*.

tion. Christ united all the Aspidium-like ferns without indusium under the genus *Phegopteris*; while Diels places them under various genera chiefly according to the venation.

12. Adiantum affine, Willd., Endl., Prod. Norf. 44.

13. Adiantum hispidulum, Swartz. (*A. pubescens*, Schk., Endl., Prod. Norf. 43).

14. Adiantum diaphanum, Blume.—I cannot find that this has been previously recorded from the Island.

15. Cheilanthes tenuifolia, Swartz, var. Sieberi. (*C. Sieberi*, Kunze).

C. tenuifolia, recorded by Mueller (Journ. Bot. xxii. 290), *C. Sieberi*, Kunze, and *C. tenuifolia*, Swartz, are distinct species in Hooker and Baker's Synops. Filic., but are united in B.Fl. vii. Christ ignores *C. Sieberi*.

C. arborescens, Sw., Endl., Prod. Norf. 45, and *C. dicksonioides*, Endl., Prod. Norf. 46, I cannot trace anywhere else. Judging from the descriptions, they both appear to be *C. tenuifolia*.

16. Nothochlaena distans, R.Br., Prod. 146, 1810. (Syn. *Cheilanthes distans*, A.Br.).—Recorded as *Cheilanthes* from the Island in B.Fl. vii. 774.

Christ and Diels (in Nat. Pfl. Fam.) both spell the genus *Nothochlaena*, and separate it from *Cheilanthes*. In New South Wales we have *Cheilanthes tenuifolia*, also *Nothochlaena distans* and *vellea*.

The chief distinction between the genera is:—

Cheilanthes—Veins distinctly thickened at the end. Margin of the fronds recurved.

Nothochlaena—Veins scarcely thickened at the end. Margin of the fronds scarcely recurved.

17. Pellæa rotundifolia, Hook. (*Pteris rotundifolia*, Forst.)—Recorded in B.Fl. vii. 730, as *Pteris*.

18. Pteris tremula, R. Br. (*Pteris arguta*, F.v.M., not Ait.).—Mueller united it erroneously with the European *P. arguta*, Ait., which it closely resembles. Recorded in B.Fl. vii. 731.

Pteris tremula, B.Br., var. *Kingiana*, Hook. and Baker, Synops. Fil. p. 161. (*P. Baueriana*, Endl., Prod. Norf. 40).

P. Baueriana, Endl., Prod. Norf. 37, appears to be a form of *P. tremula*.

19. PTERIS AQUILINA, Linn., var. ESCULENTA. (*P. esculenta*, Forst., Endl., Prod. Norf. 36 : *Pteridium aquilinum*, Kuntze).—*Pteris aquilina* is separated in the Nat. Pfl. Fam. from the genus *Pteris*, as *Pteridium*, on account of its double indusium.

20. PTERIS QUADRIAURITA, Retz.—*P. Trattinickiana*, Endl., Prod. Norf. 42, and *P. Zahlbruckneriana*, Endl., Prod. Norf. 41, both appear, from the descriptions, to be *P. quadriaurita*, but I am doubtful. *P. quadriaurita* is a new record for the Island.

21. PTERIS INCISA, Thunb. (*Histiopteris incisa*, Thunb., Agardh). Recorded by Mueller in Carne's List. Perhaps *P. Brunoniana*, Endl., Prod. Norf. 38, is the species.

22. PTERIS MARGINATA, Borz.—Recorded by Mueller (Journ. Bot. xxii. 290).

23. PTERIS COMANS, Forst., Endl., Prod. Norf. 39.

ASPLENIACEÆ.

24. BLECHNUM* DISCOLORUM, Forst. (*Lomaria discolor*, Willd.) — This species does not appear to have been previously recorded.

25. BLECHNUM LANCEOLATUM, Spreng. (*Lomaria lanceolata*, Spreng. : *Stegania lanceolata*, R.Br., Endl., Prod. Norf. 34).

Perhaps this and the following are identical, or *B. Norfolkianum* with *acuminatum*.

Blechnum Norfolkianum, Hew.

"*Lomaria norfolkiana*, Hew. (nov.sp.) (*Stegania*, A. Cunn. MSS.), frondibus glabris lanceolatis pinnatifidis, laciniis sterilibus subfalcatis acuminatis integris apice subdentatis : infimis semiorbicularibus, fertilibus angustioribus: Frons sterilis bipedalis glabra. Pinnæ 3-4 pollicares. On the margins of water courses in shady ravines."

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[*] *Lomaria* is merged in *Blechnum* by both Christ (Farnkräuter) and Diels (Pflanzenfamilien).

"This fern, which I apprehend is the same that Endlicher has taken up as *Stegania lanceolata*, R.Br., is very distinct from the Van Dieman's Land plant, resembling considerably more *Lomaria acuminata*, Desv., a native of the Mauritius, but that fern has not the semi-orbicular laciniæ of the Norfolk Island plant" (Heward's "Biographical Sketch of Allan Cunningham").

It seems strange that this name is ignored by all modern pteridologists.

26. BLECHNUM ACUMINATUM, J. G. Baker. (*Lomaria acuminata*, Baker), Hook. and Baker, Syn. Filic. 481.—Intermediate between *B. attenuata* and *B. lanceolata*.

27. DOODIA ASPERA, R.Br.

28. DOODIA MEDIA, R.Br., var. KUNTHIANA (*D. Kunthiana*, Gaud., Endl., Prod. Norf. 33).

29. DOODIA CAUDATA, R.Br. (*Woodwardia caudata*, Cav.: *D. caudata*, in Endl., Prod. Norf. 32).—In Hooker and Baker's Syn. Filic. the following species and varieties of *Doodia* are given :—

D. aspera, R.Br., *D. media*, R.Br., *D. media*, var. *Kunthiana*, *D. caudata*, R.Br.

Bentham considers *D. aspera* and *caudata* as good species, but reduces *D. media* to a var. of *D. caudata*.

Christ considers *media* and *caudata* as good species, but *Doodia aspera*, the most common of all, he does not mention. Engler and Prantl agree with Hooker and Baker, so I propose to follow the Synops. Filic.

30. ASPLENIUM NIDUS, Linn., Endl., Prod. Norf. 26.

31. ASPLENIUM ROBINSONII, F.v.M., Journ. Bot. xxii. 289. In Journ. Bot. xxiii. 353, he says :—

"While offering these remarks on a long misunderstood plant of Norfolk Island, it may not be out of place to note that the great fern investigator, Mr. J. G. Baker, refers to *Asplenium Robinsonii* as the doubtful recorded variety of *A. squamulatum* of Hooker's Spec. Filicum, iii. 83, the origin of which had remained for very many years obscure; this particular fern, now shown to be a native of Norfolk Island, is evidently not identical with Blume's *A. squamulatum* of Java, Borneo and the Philippine Islands, but probably endemic to the far-isolated oceanic spot as a remnant of a bygone vegetation, where indeed it is now nearly extinct, as trading horticulturists have carried away three of the only five individual plants known from various spots of the island. Mr. Robinson writes concerning this fern, that in habit it is not unlike *A. Nidus*, so far that four fronds gathered from one plant could scarcely be missed, and that all fronds appeared fructified, yet it shows no inclination for natural dispersion; specimens lately received exhibit the spikes semiterete and channelled, and the apex of the frond acute."

For a note on the supposed occurrence of this fern in Lord Howe Island, see these Proceedings, 1898, p. 146.

32. Asplenum obtusatum, Forst. var. difforme. (*A. difforme*, R.Br., Endl., Prod. Norf. 28 : *A. marinum*, F.v.M. not Linn.).

According to Hooker & Baker (Synops. Filic. 207) and Christ (p. 197), this variety is a form of the species with the pinnæ cut nearly down to the rhachis.

"On the rocks of the south coast, *Asplenium difforme*, a fern resembling the Sea Spleenwort, *Asplenium marinum*, of England, is found. At a short distance from the shore, its leaves become more divided, and in the woods, in the interior of the Island, they are separated into such narrow segments that the lines of fructification are thrown upon their margins. It then becomes *Cœnopteris odontites*. But every possible gradation is to be met with between this state and that in which it grows on rocks washed by the sea" (Backhouse, p. 267).

Backhouse's description of the coast form and the form of the interior does not agree with Hooker, Baker and Christ's opinion that *A. difforme*, R.Br., is a form of *A. obtusatum*.

33. Asplenium diversifolium, A. Cunn., Endl., Prod. Norf. 29 (*A. dimorphum*, Kunze).—On stems of tree-ferns (Endlicher).

34. Asplenium falcatum, Lam. (not Swartz, as in Endl., Prod. Norf. 27).

Asplenium falcatum, Lam. var. *caudatum* (*A. caudatum*, Forst.).

A. falcatum, Lam., and *A. caudatum*, Forst., are kept distinct by Hooker and Baker, and also by Christ; Bentham united them. They are certainly not synonymous; the question is whether *A. caudatum* is a variety of *A. falcatum*, or whether they are distinct species.

35. Diplazium japonicum, Thunb. (*Asplenium japonicum*, Thunb.).

Engler and Prantl, also Christ, constitute the section *Diplazium* of *Asplenium* as a separate genus. As *Asplenium*, Mueller (Carne's list) records it from Norfolk Island.

36. ATHYRIUM UMBROSUM, Presl. (*Asplenium umbrosum*, J. Sm.: *Allantodia australis*, R.Br., in Endl., Prod. Norf. 31 : *Asplenium australe*, Brack.).

Athyrium umbrosum, Presl., var. *assimile*, Hook. and Baker, Synops. Filic. (*Asplenium assimile*, Endl., Prod. Norf. 30).

Christ, also Engler and Prantl, separate *Athyrium* from *Asplenium*. A. Cunningham in Heward has the note "*Asplenium assimile*, Endl., Prod. p. 10, is *Allantodia australis*, R.Br." But according to Synops. Filic. p. 229, *Allantodia*, R.Br., is synonymous with *Asplenium umbrosum*, J. Sm., and not with its var. *assimile*.

37. ATHYRIUM BREVISORUM, Wall.,* (*Asplenium brevisorum*, Wall., Synops. Filic. p. 228).—This appears to be a new record for the Island.

ASPIDIACEÆ.

38. ASPIDIUM PARASITICUM, Mett. (*Polypodium parasiticum*, Linn. : *Nephrodium parasiticum* (Linn.), Baker: *Nephrodium molle*, R.Br. :† *Aspidium molle*, Swartz).

Christ and Diels agree that *parasiticum* should be the specific name, though they differ about the genus. Diels separates *Nephrodium* from *Aspidium* as a genus. Christ concurs with Bentham and Mueller in leaving *Nephrodium* with *Aspidium*.

The plant is recorded from the Island as *A. molle*, Sw., by Mueller in Journ. Bot. xxii. 290.

"***Nephrodium remotum***, Hew. (nov.sp.) frondibus pubescentibus lanceolatis pinnatis, pinnis lineari-lanceolatis sessilibus oblique crenatis ciliatis apice attenuatis integerrimis; infimis remotis subtriangularibus, sori medio venarum insidentibus. Frons 2-3 pedalis. Stipes venaeque pubescentes. Indusium reniforme pilosum. Shaded woods. This fern belongs to a section of *Nephrodium* extremely difficult to determine specifically, but the character of the lower pinnæ being so very distant (3 to 4 inches), and their nearly triangular form will distinguish it from its congeners. Found also at Timor, 1819" (Heward's "Biographical Sketch of A. Cunningham").

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* As *Asplenium*.

† In Syn. Filic. the author is given as Desv.

I cannot find *N. remotum*, Hew., anywhere else. *N. remotum*, A.Br., in Synops. Filic., has evidently nothing to do with this plant. If it is a good species the difficulty is under what genus to place it. In Christ's system, as already stated, *Nephrodium* has been eliminated.

Christ separates *Nephrolepis* and *Phegopteris* from *Aspidium*, as used by Bentham (B.Fl.), but writes *Nephrodium* and *Aspidium*. Perhaps *Nephrodium remotum*, Hew., or *Aspidium remotum*, according to the classification used, is synonymous with *A. parasiticum*, Mett.

39. Aspidium aristatum, Swartz, Endl., Prod. Norf. 23 (*Polystichum aristatum*, Presl.). See *A. decompositum*, Spreng.

40. Aspidium capense, Willd. (*A. coriaceum*, Swartz, Endl., Prod. Norf. 22: *Polystichum capense*, Sm.).

41. Aspidium decompositum, Spreng. (*Nephrodium decompositum*, R.Br., and *N. microsorum*, Endl., Prod. Norf. 24, and *N. calanthum*, Endl., Prod. Norf. 25 probably).

A. Cunn. in Heward states :—

> "*Nephrodium microsorum*, Endl., and *N. calanthum*, Endl., Prod. p. 9, I have little hesitation in considering the same plant, the latter having its sori somewhat more elaborate. At the same time, from comparison of specimens in the Banksian herbarium, I have every reason to believe the two plants are identical with *Aspidium* (*Polystichum*) *aristatum*, Sw."

But *Nephrodium microsorum*, Endl., and *N. calanthum*, Endl., seem to be both identical with *Aspidium decompositum*, Spreng., (*Nephrodium decompositum*, R.Br.). Endlicher distinguishes between the genera *Aspidium* and *Nephrodium* (*Aspidium*: *indusium orbicular*, peltately attached. *Nephrodium*: *indusium reniform*, attached in the sinus); and as *Nephrodium microsorum* and *N. calanthum* have both a reniform indusium, they cannot be identical with *Aspidium aristatum*.

Nephrodium microsorum and *N. calanthum* are only distinguished by the one being more membranous than the other;

and one has "rather acutely lobed pinnæ" and the other "very acutely lobed pinnæ," a difference readily accounted for by the variation in the forms of *A. decompositum.*

Aspidium decompositum, Spreng., (described 1827), has a wide range, from Australia to New Zealand and the Pacific Islands, and is very variable in size, outline and hairiness, so that its occurrence in Norfolk Island is probable.

42. **ASPIDIUM TENERUM**, Spreng. (*Nephrodium tenerum*, R.Br.) —Recorded by Mueller in Carne's list.

43. **ASPIDIUM SETIGERUM**, Blume. (*A. uliginosum*, Kunze: *A. tenericaule*, Thw.).—Recorded by Mueller (Journ. Bot. xxii. 290) as new for the Island, under the name of *A. uliginosum.*

44. **PHEGOPTERIS PUNCTATA**, Thunb., Bedd. (*Polypodium punctatum*, Thunb: *P. rugulosum*, Labill.).—Perhaps a new record.

45. **HYPOLEPIS TENUIFOLIA**, Benth.—A hairy variety of the species (as collected by Mr. Boorman and myself). Recorded as new for the Island by Mueller (Journ. Bot. xxii. 290).

DAVALLIACEÆ.

46. **NEPHROLEPIS CORDIFOLIA**, Presl. (*Aspidium cordifolium*, Bory).—Recorded as new for the Island by Mueller (Journ. Bot. xxii. 290).

47. **LINDSAYA LINEARIS**, Sw.—Recorded from the Island in B.Fl. vii. 719.

48. **DAVALLIA PYXIDATA**, Cav.—Recorded from the Island in B.Fl. vii. 716.

49. **DENNSTÆDTIA DAVALLIOIDES**, T. Moore. (*Dicksonia davallioides*, R.Br.: *Davallia dicksonioides*, F.v.M.)—Recorded from the Island in B.Fl. vii. 713 as *Dicksonia.*

CYATHEACEÆ.

Cyathea medullaris, Swartz, Endl., Prod. Norf. 47.

"*Cyathea medullaris*, Sw., has been enumerated by Endlicher (Prod. p. 15) as a native of Norfolk Island; Mr. Cunningham did not find it, and says:— 'This fern tree is not indigenous to Norfolk Island; it was not seen there by

Ferd. Bauer,* nor has it been since observed by other botanists. Mr. Brown has ascertained that it is not noted by Forster, in his herbarium, as a native of Norfolk Island, and it is therefore probable that Endlicher on reading Lieut.-Govr. King's remarks in Hunter's Voyage, p. 313, had concluded that it referred to *Cyathea medullaris*, a plant found only in New Zealand, and has on this conclusion inserted it. Lieut.-Govr. King thus describes the Norfolk Island plant:—'This tree grows to the height of 80 feet (one trunk which I felled in 1830 measured 57 feet without the fronds, A.C.) and the branches, which resemble those of the palm tree in their growth, fall off every year, leaving an indentation on the trunk. The leaves of these branches, which are twelve in number, are much like the heath fern, from whence this tree obtained the name of the fern-tree. The middle of the tree, from the root to the apex, consists of a white substance resembling a yam, and when boiled it tastes like a bad turnip; this the hogs feed on very eagerly; the outside of the trunk is hard wood, and full of regular indentations from the top to the bottom. The tree is found in great plenty in all parts of the Island.' This is the *Alsophila excelsa* of Mr. Brown, of which the late Ferd. Bauer made some magnificent drawings during his stay on the Island in 1804" (Heward).

"I explored some of the gullies on the south of Mount Pitt. Here two tree-ferns, *Alsophila excelsa* and *Cyathea medullaris* were very fine; the former measured 40 feet, and the latter 20 feet, in height; both had magnificent circular crests of fronds: those of the *Cyathea* were 11 feet in length" (Backhouse, p. 273).

Under *C. medullaris*, Swartz, Hooker (Hdbk. N.Z. Flora, 349) says of the New Zealand plant:—

"This differs from the Norfolk Island and Pacific Island allied species in the fertile pinnæ being always lobulate, or almost pinnatifid. The thick mucilaginous pith was once an article of food with the natives."

Bentham (B.Fl. vii. 709) includes in the range of this species "Malayan Archipelago and the South Pacific Islands."

50. Alsophila excelsa, R.Br., Endl., Prod. Norf. 48.—A MS. says:—

"Tree fern *Alsophila excelsa* measures 40 feet in height and has a magnificent crest of fronds; the black portion of the trunks is used for stringing by cabinetmakers."

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* A letter from Mueller contains the passage:—"*Cyathea medullaris*. This tree-fern, besides *Alsophila excelsa*, was found by Bauer." I could not find it at Norfolk, and believe there is only one tree-fern on the Island. I do not understand Backhouse's specific statement that he saw two.

Dr. Metcalfe told me that the fern grew up to 60 feet in height. It is, or has been, so abundant that I saw a corduroy road of Tree-fern stems!

Lieut.-Govr. King writes, presumably referring to this species:

> "The fern-tree is, likewise, found of a good height, measuring from seventy to eighty feet, and affords good food for the hogs, sheep, and goats, all which thrive" (Hist. Rec. N.S.W. Vol. i. Pt. 2, p. 187).

A. australis, R.Br., is (in B.Fl. vii. 711) recorded from Norfolk Island in the following words:—

> "In the typical *A. australis*, chiefly from N.S. Wales and Tasmania, but also among Queensland and Norfolk Island specimens, the ultimate pinnules are thin, rather acute, barren and serrulate at the end, the sori not reaching beyond the middle. In the Norfolk Island form originally described as *A. excelsa*, the pinnules are longer, narrower, thicker, obtuse with recurved margins, soriferous and entire or obscurely crenate to the end. But some Norfolk Island specimens are the precise counterpart of Brown's from King's Island."

Tate follows Bentham in recording *A. australis* and excluding the name *A. excelsa* from Norfolk Island. In my opinion *Alsophila excelsa*, R.Br., from Norfolk Island, and *A. australis*, R.Br., are perfectly distinct species.

Bentham, working only on herbarium material, united *A. excelsa*, as well as *A. Cooperi* with *A. australis*; but he would hardly have done so if he had seen the living plants.

Alsophila australis has a rough stem, studded with the prickly bases of the stalks of the fronds; while *A. excelsa* and *A. Cooperi* have smooth stems; the fronds drop off completely, leaving a smooth scar on the stem. *A. australis* is also more prickly, less scaly-hairy, and altogether different in habit from *A. excelsa* and *A. Cooperi*.

Mueller, in his Census, followed R. Brown, and kept *A. excelsa* and *A. australis* apart as distinct species; and I think that is the correct view.

I believe Mueller united *A. Cooperi* and *A. excelsa*, and the note in Census, "*A. excelsa* . . . N.S.W. . . Q.," refers to *A. excelsa* from Norfolk, and *A. Cooperi* from Australia.

MARATTIACEÆ.

51. MARATTIA FRAXINEA (*M. elegans*, Endl., Prod. Norf. 17).

"The most remarkable object that arrested our attention was *Marattia elegans*, a fern of great beauty, having fronds 14 feet in length, 7 feet of which were destitute of branches; of these it had 8½ pairs, which were again branched, and clothed with leaflets, five inches long, and three-quarters of an inch broad" (Backhouse, p. 272).

I learnt that the Norfolk Island name (as also that of Pitcairn) for the plant is Neh-e (pronounced Neehe-e, with a peculiar nasal sound, to imitate ba-a of a lamb). I did not think to ask the meaning of the allusion to the lamb, but the so-called Scythian or Tartarian lamb has since occurred to me. This lamb consists of the shaggy caudex of a fern with portions of the stipes for legs. See *Cibotium* (Treasury of Botany) for a full account of this fabulous animal. *Marattia* would not make so good a lamb as *Cibotium*.

OPHIOGLOSSACEÆ.

52. OPHIOGLOSSUM VULGATUM, Linn.—Recorded as new by Mueller (Journ. Bot. xxii., 290).

b. **Lycopodinæ.**

1. LYCOPODIUM DENSUM, Labill.—Recorded in B.Fl. vii. 676.

2. TMESIPTERIS TANNENSIS, Bernh. (*T. Forsteri*, Endl., Prod. Norf. 16; probably syn. with *T. tannensis*).—On tree-ferns.

3. PSILOTUM TRIQUETRUM, Sw., Fil. p.187; Schk., Crypt. t. 165 b. —"On decayed trees in shaded woods" (A. Cunn. in Heward).

ii. BRYOPHYTA.

a. **Musci.**

ORTHOTRICHEÆ.

1. MACROMITRIUM PROREPENS, Hook. (Endl., Prod. Norf. 6, as *Leiotheca*).

BRYEÆ.

2. BRYUM ANGEIOTHECIUM, C.M. (Hedwigia, 1898, 108).

3. BRYUM CANARIENSE, Brid. (Endl., Prod. Norf. 5).

4. RHIZOGONIUM SPINIFORME, Linn. (Endl., Prod. Norf. 8, as *Rhizogonium*).

RHACOPILEÆ.

5. RHACOPILUM TOMENTOSUM, Brid. (Endl., Prod. Norf. 11).

STEREODONTEÆ.

6. ISOPTERYGIUM INTORTUM, P.B. (Endl., Prod. Norf. 7, as *Hypnum*).

HYPNEÆ.

7. HYPNUM CIRCINALE, Hook. (Endl., Prod. Norf. 9).

8. THUIDIUM MINUTULUM, Hedw. (Endl., Prod. Norf. 9, as *Hypnum*).

b. **Hepaticæ.**

JUNGERMANNIACEÆ.

1. PLAGIOCHILA SINCLAIRII, Mitt.
2. JUNGERMANNIA ARGUTA, Nees ab E. (Endl., Prod. Norf. 12).
3. J. DUBIA, Nees ab E. (Endl., *l.c.* 15).
4. J. ENDLICHERIANA, Nees ab E. (Endl., *l.c.* 13).
5. J. SECURIFOLIA, Nees ab E. (Endl., *l.c.* 14).
6. LOPHOCOLEA CILIATA, Steph.
7. BRYOPTERIS VITTATA, Mitt.
8. OMPHALANTHUS CONVEXUS, Steph.

MARCHANTIACEÆ.

9. MARCHANTIA POLYMORPHA, Linn.

ANTHOCEREÆ.

10. ANTHOCEROS LÆVIS, Linn.

(The Hepatics, other than *Jungermannia*, were recorded by Mueller in Journ. Bot. xxiii. 353.)

iii. THALLOPHYTA.

a. **Lichenes.**

Mr. E. Cheel, Botanic Gardens, Sydney, has kindly given me the following statement of the Norfolk Island Lichen-flora, so far as has been ascertained at present. Those marked F. v. Mueller in brackets were communicated by that botanist in a letter. The determinations were by Mueller Arg., and I do not know whether they have been previously published. The remainder, unless otherwise indicated, were collected by Mr. Boorman and myself.

Order **Collemaceæ.**

Tribe COLLEMEÆ.

1. LEPTOGIUM TREMELLOIDES, Linn.

2. PHYSMA BYRSINUM, Ach.—On trunk of *Pittosporum bracteolatum.*

Order **Discocarpeæ.**

Series THAMNO-PHYLLOBLASTEÆ.

Tribe USNEÆ.

3. USNEA BARBATA, Ach., and var. FLORIDA (Linn.), Fr.—On dead branches.

4. U. INTERCALARIS, Krp.—On dead branches. *Usnea* is common on the Pines from top to bottom on the W. side.

5. EVERNIA MELAXANTHA, Ach., Endl., Prod. Norf. 4.

It is quite probable this is meant for *Neuropogon melaxantha*, Nyl. *Neuropogon melaxantha*, however, has never, so far as I can ascertain, been found in other than Arctic and Antarctic regions, or on very high mountains. Specimens in the National Herbarium, Sydney, are from Mt. Wellington, Tas., Mt. Macedon, Vic., and from mountains 3000 feet high in New Zealand. There are also specimens from Mt. Kosciusko, N.S.W., collected by J. H. Maiden.

Tribe RAMALINEÆ.

6. RAMALINA LEIODEA, Nyl., var. FASTIGIATA, Muell. Arg.—On dead branches in company with *Usnea florida.*

7. R. FARINACEA, Linn.—On dead branches in company with *R. fastigiata.*

R. thrausta (Ach.), Fr.?—Only fragmentary specimens were present, in company with *Thelochistes flavicans.*

8. R. SCOPULORUM, Ach.—On trunks of *Araucaria excelsa* (A. Cunn. in Heward).

It is quite probable that this species may occur in Norfolk Island, but it is questionable if those plants collected by A. Cunningham on trunks of *Araucaria* are the true *R. scopulorum* of Acharius, as they have never (so far as I can ascertain) been found on other than maritime rocks.

Tribe STICTEÆ.

9. STICTA AURATA, Ach.—On decaying logs. Previously recorded in Endl., Prod. Norf. 3.

Tribe PARMELIEÆ.

10. PARMELIA PERLATUS, Linn.—On dead branches. Previously recorded in Endl., Prod. Norf. 1.

Tribe PHYSCIEÆ.

11. THELOCHISTES FLAVICANS, Sw.—Sterile.

12. PHYSCIA CÆSIA, Hoffm.—On bark. Previously recorded in Endl., Prod. Norf. 2, as *Parmelia cæsia*, Ach.

13. P. CONFLUENS, Mitt.—Sterile. On branches of trees.

14. ANAPTYCHIA CILIARIS (Linn.), Kœrb.?—The laciniæ are more tubulose-inflated than those of the specimens in the National Herbarium. The spores are the same.

Series KRYOBLASTEÆ.

Tribe PYXINEÆ.

15. PYXINE COCOES, Sw.—On bark.

Tribe PHYLLOPSOREÆ.

16. PSORA PARVIFOLIA, Muell. Arg. (F. v. Mueller). (Syn. *Lecidea parvifolia*, Pers. = *Lecanora bibula*, Tayl., in Shirley's Lich. Fl. Queensl. p. 106 = *Lecidea breviuscula*, Nyl., in Shirley, *l.c.* p. 107, *vide* list of synonyms, *l.c.* p. 196.

Tribe LECANOREÆ.

Lecanora pallescens, Fr.?—Only fragmentary specimens of this were present. Spores undeveloped; probably as above named.

Pertusaria sp.—On bark, only fragments were present; more specimens required to give it specific rank.

Tribe LECIDEEÆ.

17. PATELLARIA VERSICOLOR, Fée.—On bark.
18. P. GROSSA, Muell. Arg. (F. v. Mueller).
19. HETEROTHECIUM BIFLORUM, Nyl. (F. v. Mueller).

Tribe CÆNOGONIEÆ.

20. CÆNOGONIUM IMPLEXUM, Nyl. (F. v. Mueller).

Tribe GRAPHIDEÆ.

21. GLYPHIS VERRUCOSA, C. Kn.—On trunks of trees.
22. CHIODECTON PERPLEXUM, Nyl. (F. v. Mueller).

Order **Pyrenocarpeæ.**

Tribe PYRENULEÆ.

Parmentaria sp., probably *P. havenlii*, Tulk.—Specimens are very young; older ones required for identification.

Pyrenula sp., probably *P. nitida*, Ach.—On decorticated bark.

23. CLATHROPORINA EMINENTIOR, Nyl. (F. v. Mueller).

b. **Fungi.**

The following list of fungi for the Island was published by Mueller :—

1. HYMENOCHÆTE PURPUREA, C. & M.
2. DALDINIA VERNICOSA, Fries.
3. TREMELLA LUTESCENS, Fries.
4. THELEPHORA CAPERATA, Berkeley.
5. POLYPORUS AUSTRALIS, Fries.
6. P. HIRSUTUS, Fries.

7. Xylaria Schweinitzii, Berkeley.

8. Hypocrea fusaroides, Berkeley.

9. Stereum lobatum, Kunze.

To which are to be added:

10. Polyporus sanguineus, Meyer.

11. Hirneola Auricula-Judæ, Fries.

And a species of

12. Aseroe (Journ. Bot. xxiii. 353-54).

The Jew's Ear fungus (*Hirneola*) is a regular article of export from the Island. It is chiefly collected on Wild Tobacco (*Solanum auriculatum*), Pine (*Araucaria excelsa*), and White Oak (*Lagunaria Patersonii*). The Chinese are said to extract a dye from it; they eat the jelly.

Mr. A. Grant informs me that an *Agaricus* (Section *Pleurotus*) is probably referred to in the following passage:—

> "Being out after dark, we were interested by seeing numbers of a small species of agaric, or mushroom, so luminous as to reflect a shadow on substances near them. When held near a watch, the hour might be distinctly seen, or on being put near the face, the features might be discovered. This remarkable fungus has attained the name of Bluelight, though its radiance is rather green than blue; it grows from decaying sticks or straw, and is very abundant amongst the sugar-canes, as well as in the bush. Its cap is rather convex, covered with mucilaginous matter, and is less than an inch across; the stalk is slender, two or three often grow together; the whole plant is very watery. The brilliancy is greatest in the cap, which shines most on the under side" (Backhouse, p. 275).

Mr. Boorman and I collected a number of fungi, and Mr. A. Grant, of the Botanic Gardens, informs me that one of them

13. Lentinus exilis, is new for the Island.

c. Algæ.

Mr. A. H. S. Lucas, M.A., B.Sc., writes:—"Among the *Algæ* collected by Mr. Robinson, yourself, and Mr. Boorman on Norfolk Island in Nov., 1902, I have been able to determine the following species, viz.:—

1. Padina pavonia (L.), Lamx.

2. PADINA DURVILLÆI, Bory.
3. DICTYOLA DICHOTOMA (Huds.), Lamx.
4. GELIDIUM LATIFOLIUM, Bornel.
5. PTEROCLADIA LUCIDA (R.Br.), J. Ag.
6. PLOCAMIUM HAMATUM, J. Ag.
7. CHAMPIA PARVULA (Ag.), J. Ag.
8. AMPHIROA ANCEPS, Lamx.
9. A. EPHEDREA, Lamx.
10. ULVA LÆTE-VIRENS, Areschoug.

There are seven or eight others which require further consideration." I am not aware that a list of Algæ from Norfolk Island has previously been published.

Plocamium has been previously recorded from the Island.

Introduced Plants.

List A.—Natives of Australasia.

It is very important that a list should be kept of Australasian plants which have been introduced from the mainland. Without such a record it is quite possible that some of them might be deemed to be indigenous, and hence erroneous deductions as to plant distribution might readily be made.

PITTOSPOREÆ.

PITTOSPORUM UNDULATUM, Vent., is known as "Snowdrop-tree" in the Island. I have no doubt that it is not indigenous. It occurs on the site of the old Government garden at the Cascades and in other places where it has been doubtless planted.

MELIACEÆ.

MELIA AZEDARACH, "White Cedar." Very common, and looked upon by some of the Islanders as indigenous.

CEDRELA AUSTRALIS, F.v.M., "Red Cedar." One or two planted trees on the Island.

LEGUMINOSÆ.

ALBIZZIA LOPHANTHUS, Benth.—A native of Western Australia and well acclimatised. Known as "Wattle."

ACACIA MELANOXYLON, R.Br.—"Blackwood" of the mainland. Planted by Col. Spalding.

CASTANOSPERMUM AUSTRALE, A. Cunn.—"Moreton Bay Chestnut." In various places and up to 3-4 feet in diameter.

ERYTHRINA sp.—Known as "Willow."

MYRTACEÆ.

CALLISTEMON LANCEOLATUS, DC—In a garden near the Cascades. There when the Pitcairners arrived.

METROSIDEROS VILLOSA (Syn. *M. polymorpha*, Gaud.).—"Pohutukawa" of N.Z. Planted in the Melanesian Mission Ground.

EUCALYPTUS GLOBULUS, Labill.—"Tasmanian Blue Gum." An avenue planted on Mr. Buffett's property, Steel's Point, as a breakwind. Isolated trees in other parts.

EUCALYPTUS CALOPHYLLA, R.Br.—From Western Australia. A fine tree in "Nat's" Garden in Ferny Lane. There are others.

VERBENACEÆ.

VITEX LITTORALIS, Forst. This is also found in New Zealand. There is nothing inherently improbable in its being indigenous to Norfolk Island. I saw several trees growing among other trees (indigenous), but I was informed they had been planted.

PROTEACEÆ.

HAKEA aff. *aciculari*, but differing in the long hairy leaves. It was introduced by the Melanesian Mission many years ago as a hedge, but has not proved a success. It cannot be determined in the absence of flowers. It is 8 ft. high and 10 ft. broad.

THYMELEACEÆ.

PIMELEA LINIFOLIA, Sm., Endl., Prod. p. 46.

"Certainly not indigenous to Norfolk Island, and if it ever grew there it must have been introduced from Port Jackson by the first settlers as an ornamental plant, and upon the island being abandoned in 1807, the plant left to itself must have died, not liking that continued humid atmosphere which prevails during the winter months. I found no trace of it in 1830" (A. Cunn. MSS. in Heward).

I also searched in vain for the plant.

P. longifolia, Bks. & Sol., of New Zealand and Lord Howe Island, does not appear to extend to Norfolk Island.

EUPHORBIACEÆ.

ACALYPHA sp., from Fiji, is commonly found in gardens.

HOMALANTHUS POPULIFOLIUS, Grah., found in Lord Howe Island and in other South Sea Islands, is not indigenous, I believe, to Norfolk Island. I found a flourishing tree on Colonel Spalding's land; but that gentleman informed me it had come as a seedling with some plants from Lord Howe Island. It is interesting to trace the history of a plant like this, as a botanist might be excused for recording it without question as indigenous to Norfolk Island.

URTICEÆ.

FICUS COLUMNARIS.—The Banyan from Lord Howe Island.

FICUS MACROPHYLLA, Desf.—"Moreton Bay Fig."

CASUARINEÆ.

CASUARINA GLAUCA, Sieb. (?), determined in absence of fruits. This is a planted species found in several parts of the Island (*e.g.*, Orange Vale and Mr. Fletcher Nobbs' property) where it goes under the absurd name of "Scotch Fir."

Introduced Plants.

List B.–Miscellaneous Plants of Economic and Horticultural Value.

Some of the islanders are very fond of flower gardens, and have a veritable blaze of flowers. At the same time, with the conditions so favourable, the flower gardens ought to be greater in number. Many of the ordinary herbaceous plants found in Sydney gardens are to be seen on Norfolk Island. Following are some miscellaneous trees, shrubs and miscellaneous plants, not previously enumerated, observed by me. They are chiefly of an ornamental character :—

Trees.

English Oak.

Pepper-tree (*Schinus molle*).

Cupressus macrocarpa.

Weeping Willows.

Salisburia adiantifolia (Maidenhair Tree).

Robinia pseud-Acacia

Yucca aloifolia.

Agave americana (American Aloe).

Fourcroya gigantea (Mauritius Hemp).

Arum Lily (*Richardia*), here known as Water Lily.

Strelitzia Nicolai.

Lilium Harrisii longiflora (White Lily, which does remarkably well all over the island).

Alstrœmeria peregrina in gardens, and also an escape.

Bambusa arundinacea (Large Bamboo) forming some noble clumps.

Ficus repens (Creeping Fig), on the Patteson Memorial Church. It would add much to the picturesqueness of the buildings if this Fig were very freely planted.

Hedge-plants.

Duranta stenophylla, the only Duranta in the Island, makes a splendid hedge, and is often used for that purpose. A similar observation may be made in regard to *Tecoma capensis*, which is very abundant.

Miscellaneous shrubs.

Datura suaveolens (Trumpet flower), which grows wild.

Begonia semperflorens. Huge plant six (6) feet through and the same across, a very blaze of flowers. I am told it is always in flower and it is a sight to remember.

China Rose ("Lady Brisbane") in great profusion and sometimes wild.

Oleander, in great profusion, and even wild.

Periwinkle, wild.

Fatsia papyrifera (Chinese rice-paper plant) grows wild in the Mission ground.

Myrtle (*Myrtus communis*).

Rhododendron ponticum (a common sort).

Ligustrum japonicum.

Crotons.

Jasminum Sambac.

Franciscea.

Nandina domestica.

Hibiscus sinensis.

Some other plants are referred to below in botanical sequence.

Cereals and other Grasses.

Maize.—This is, of course, one of the first crops ever grown on the Island. I was informed that four sorts are principally cultivated, viz. :—

(1). Ninety-day.
(2). Red (the sort commonly grown in the Island).
(3). White.
(4). Red and white, with large flat grain.

A little Sweet Corn and Pop Corn are also grown.

I did not see a cob of any of the sorts, except No. 3, and, owing to the drought, which continued at the time of my visit, the maize was in such a backward condition that I could form no opinion as to the crops. I was informed that the Department of Agriculture had sent about 20 sorts of maize to the Island last year for experiment, but all that I could ascertain from the people was "Some did well and some did not." This little incident tends to show that it is of little use conducting experiments except under the auspices of some responsible official—say a gardener in charge of a small experimental area. Maize is cultivated by most householders; it is used for fowl-feed, but very rarely for horses. The horses are chiefly grass-fed, and most of them do not know the taste of corn and will not eat it.

A little pop corn is utilised, and some sweet corn is used as a vegetable. The white corn, ground, mixed with a little flour and milk into a "corn cake," is often used as an article of food.

I could obtain no figures as to the yield of maize on the Island. None is exported at present. The Island could produce a vast amount of corn if required, but it must be borne in mind that the New Hebrides and other islands can also grow corn even more readily and compete with New South Wales in the Sydney market in regard to this commodity.

Wheat.—The first record of the cultivation of wheat is Lieut.-Govr. King's statement, on 3rd June, 1788, "Began breaking up part of the ground on the N.E. side of the hill to sow wheat."

As the settlement progressed wheat and maize were stored for the use of the settlement, and also sent to Port Jackson.

On the hill, at the back of the Church of England, are nine (9) very large brick silos, locally known as "Mummies," with a deep protecting drain. These were used for the storage of grain, and it would be interesting to know when they were constructed. I have a note, "On 8th June, 1839, the silos at the back of the Commissariat store were filled with maize and sealed."

The following hitherto unpublished table shows the return of white crops for the twelve (12) years ending 1843:—

Year.	Maize.		Wheat.		Rye.		Barley		Oats.	
	No. of Acres.	No. of Bushels	No. of Acres.	No. of Bushels	No. of Acres.	No. of Bushels	No. of Acres.	No. of Bushels	No. of Acres.	No. of Bushels
1832	226	2889	100	396	...	...	..	...	...	...
1833	140	2950	82	496	...	..	...	...	...	...
1834	275	3927	97	1053	...	...	...	...	...	...
1835	398	4690	130	1580	...	...	...	..	...	...
1836	386	15914	141	4495	6	194	...	...	...	...
1837	506	20935	200	398	10	284	...	...	...	...
1838	735	21245	231	2235	21	500	24	764	...	...
1839	818	26882	206	1487	43	244	79	1435	...	...
1840	905	27078	237	3442	14	84	50	900	15	354
1841	815	21596	275	1400	8	91	59	1005	31	994
1842	619	7625	303	2424	7	188	28	288	24	960
1843	615	8379	84	546	58	1456	56	1645	25	750

Wheat is no longer a crop. Buckwheat and White Clover are on the Island. I saw a little Lucerne, but it does not appear to be cultivated now.

Miscellaneous Grasses.

Paspalum dilatatum, Poir., introduced by Colonel Spalding.

Stenotaphrum americanum, Schrank, the common Buffalo Grass of Australia, but not of America.

Sorghum halepense, Pers. (Syn. *Trachypogon avenaceus*, Nees, Endl., Prod. Norf. 55). Hay grass of the Island.

Phalaris canariensis, Linn. "Canary Grass."

Ammophila arundinacea, Host. (*Psamma arenaria*, Rœm. & Schult.). The Marram Grass, planted at Emily Bay.

Dactylis glomerata, Linn. "Cocksfoot."

Bromus arenarius, Labill. (?) No specimens brought.

Bromus unioloides, H. B. and K. (*Ceratochloa unioloides*, DC.).

Lolium perenne, Linn. "Rye Grass."

Couch (*Cynodon dactylon*) is the common pasture grass of the Island. Evidence of its value as fodder is the fact that the stock rarely feed on anything else, and look well on it.

Buffalo Grass (*Stenotaphrum americanum*) is now conmon on the grassy hills adjacent to the Cascades, and is spreading over the Island, having been deliberately planted by the people. With us it is looked upon as of little value, as stock rarely eat it, and thus it encroaches on the more valuable Couch. In Government House Grounds, Sydney, for example, the State has been to very considerable expense in eradicating Buffalo Grass, as stock will not touch it, and it threatened to destroy the fine grass in the paddocks. I would, therefore, urge on the Islanders the very great desirability of not further planting Buffalo Grass until it has been proved that it is nutritious, and that it is readily eaten by stock. I am quite aware that it is possible for a grass to be a pest in the pasture in New South Wales and a valuable fodder plant in Norfolk Island, but the onus of proof rests with those who propagate it. Of course it is a valuable sand and earth binder, and hence is useful for the construction of banks, etc., by engineers.

The Marram Grass, planted in the vicinity of Emily Bay a few years ago, is flourishing, and no doubt will in time prove a valuable sandstay. But the fences are down in some places, and horses and cattle get in and damage it, so that it does not have perfectly fair play.

I am not aware that grasses (except a little Barley and Oats for hay at the Melanesian Mission) are now artificially sown, or that ensilage is made of any forage plants.

ROOT CROPS.

Yams are cultivated to some extent by the Islanders, but on a much greater scale by the Melanesian Mission. By the former they are used as a vegetable, like potatoes. Lieut.-Govr. King speaks (under date 19th April, 1788) of "the yams now thriving very well."

Sweet Potato.—Backhouse (p. 260) speaks of the abundant use of the Sweet Potato in his time. He says "they are excellent for food, either roasted, boiled, or fried in slices. When prepared by frying, this root resembles sweetish cake, and sometimes supplies the place of toast at breakfast."

Downing (who copied a good deal from Backhouse) calls it the Sweet Potato or "Buck," a term not in use on the Island at the present day. It is universally known as Kumara (pro. Koomara), which is the Tahitian and Maori name. The Islanders grow them in very large quantities, and at the Melanesian Mission they form such an important part of the diet of the natives that their cultivation and consumption may be fitly termed enormous. The kinds chiefly grown at present are the Tongan, Portuguese and Sunday Island, but additional and improved varieties are much required.

Arrowroot.—Downing wrote in 1851:—"The Arrowroot is very extensively and successfully cultivated in Norfolk Island. The starch is separated in the usual manner, in the months of September and October, and is found to be of superior quality." The plant yielding it is a Maranta, and it was supplied from the West Indies by Government, through the Sydney Botanic Gardens, many years ago. Very little is now made, and only for private use. It is of good quality. I brought some to Sydney and subjected it to practical test. On enquiring why the industry was dying out, I was told, "It's too hard work." It seems a pity that a useful minor industry like this should die out. The people are acquainted with the technique of the manufacture, and I see no reason why, providing there is no tariff difficulty in the way, the Norfolkers should not have a fair share of the Sydney market for their product.

Potato.—Downing wrote in 1851 :—"The common or round potato is cultivated, but not with success, although four crops are produced yearly from the same soil. There is a great tendency to run to stalk, from the rapidity of growth, and the tubers are generally small and watery." I tasted some very good potatoes, although there is a tendency towards too much planting on the same soil, and too little change of seed.

Fruits.

Banana.—On 18th October, 1796, Lieut.-Govr. King reported :—"The bananas *found on the island* and those brought from the Brazils grew to a very great perfection, the bunches weighing from 40 to 80 lb. each."

Collins (2nd ed. 149) states that King was of opinion that the Island had contained aboriginal inhabitants "from discovering the banana tree growing in regular rows." But see my remarks under *Colocasia*, p. 723. Endlicher, Prod. Norf. 75, admits *Musa paradisiaca*, Linn., into the flora on this evidence. He quotes Collins (2nd ed. 311), but I cannot find the reference, and Hunter (p. 290) (I note Hunter, pp. 306 and 308), but perhaps in a German edition, and there is no reference at this page of the English edition. I am of opinion that the Banana was not found on the Island prior to the advent of the white man, and that the record has arisen through some confusion with a note of King's (see p. 723). At the same time King's remark above, in italics, is very definite. Bananas have long been a staple article of food of the people, and I feel sure that the small export trade in this commodity could be very largely developed. They are eaten at every meal, and are largely used as a vegetable.

There are, of course, many kinds of Bananas, and the shortness of my stay prevented my making careful enquiry into the names and merits of the various kinds. The following sorts are recognised, and I will endeavour to make the list complete at some future time:—

1. China (Cavendish).

2. Sydney (so called because it came from Sydney Botanic Gardens). (*Musa sapientium*). It is very much esteemed. Best for eating.

3. Pear (flavour of pear, from Fiji).

4. "Japanese." Very large bunches. (Also known as Dr. Codrington's).

5. Pitcairn, or "Home" (the most esteemed banana by some people).

6. Plantain (*M. paradisiaca*).

7. "Putter," from the name of the person who brought it from Lifu.

Apples.—On 18th October, 1796, Lieut.-Govr. King reported: "The apple trees brought from the Cape in 1791 have born very fine fruit." Apples do not, however, do well. Nor do pears; only one kind of pear (the Chinese Pear) does fairly well.

Peaches are poor. Nectarines have nearly died out. There will always be hindrance to development of the cultivation of such plants until such time as the Islanders know how to graft fruit trees.

Apricots rarely, if ever, bear. Perhaps the climate is too hot.

I saw no Almonds. If this tree has not been tried it ought to be.

There is an inferior kind of Quince.

The Loquat is almost a weed, but the large-fruited sort is a desideratum.

Grape-vine.—Norfolk Island is not adapted to the cultivation of the vine. It simply runs wild, and produces small grapes. The Isabella Grape, however, flourishes, and is free from disease.

Guavas.—Lieut.-Govr. King wrote on 18th October, 1796, that there was a great abundance of Guavas. Backhouse (p. 274) wrote:—"Guavas are now ripe; they are so abundant on various parts of the Island that the supply is more than sufficient for man, pigs and birds, all of which consume great quantities of them."

At the present time guavas constitute one of the most formidable weeds on the Island. There are small forests of them, in many cases over-running good land, to the detriment of the cultivator. It is the ordinary Yellow Guava which is in such profusion, and it yields two crops a year. In addition the "Blue Guava" (*Psidium Cattleyanum*) is common. There are also a few trees of Parker's Hybrid, which were introduced by Dr. Metcalfe.

Citrus fruits (Lemon).—Of this fruit there was "a great abundance" as early as 18th October, 1796, according to Lieut.-Govr. King. It is now one of the principal weeds of the Island, utilising good land, of course. Its spread is owing to the combined action of birds and stock. In places its thorns present a formidable barrier to a passage through the bush. Most of the lemons are thick-skinned, and would be of very little value. But a matter for consideration by the officer in charge of an experimental farm would be to ascertain if these lemons, whose only cost is that of gathering, could be used for the manufacture of citric acid.

The stock is obviously most vigorous, and one of the first functions of a gardener in charge of an experimental farm would be to show the Islanders how to bud and graft Lisbon and other lemons on the common stock.

I saw Lisbon lemons in very few properties. Col. Spalding has two hundred which have only been planted two (2) years. They are 8 ft. high, and have already cropped.

That there is money for Norfolk Island in the lemon industry I am quite sure. Lisbon lemons should be grown, and they should be carefully graded and packed.

Citrus fruits (Orange).—These useful trees grow wonderfully well. Many of the trees are, in fact, growing wild. They are almost entirely free from scale. But there is practically no market for them, and hence no special inducement to the Islanders to cultivate. A consignment is eaten up with expenses in the Sydney market, while the arrangements for conveying fruit in the steamers are very defective, and entail great loss on the growers. Surely improvements are to be looked for both in regard to the carriage of the fruit and in regard to the marketing in Sydney. The quality of most of the fruits is simply delicious. I shall ever retain pleasant recollections of Norfolk Island Oranges.

The Mandarins grow in great profusion, and colour marvellously well. The quality of the fruit is good, but not so good as that of the ordinary oranges.

There are a few Citrons and Shaddocks, while at the Mission Station are some Limes. The Lime is a very old introduction. Lieut.-Govr. King records, under date 3rd June, 1788, that he brought it with him at the settlement of the Colony.

Olive.—I saw a tree 5 feet through at the base. The Wild Olive is abundant, and there can be no doubt that the Olive thrives in the Island. But I saw no good sorts, and it would be desirable to introduce the best varieties. The gathering of olives (a tedious process, yet light work, suited for women and children), the pickling of them or the expression of oil, seem to me suitable employment for the inhabitants of Norfolk Island.

Strawberries.—Considering the latitude of Norfolk Island, the strawberry crops were a revelation to me; and their success is of course to be attributed to the rich, stiff basaltic soil. What I chiefly saw were a round fruit (? Keen's Seedling) and a pointed one (? Marguerite). They were growing in great profusion, and I feasted upon them every day. The quality was excellent, and I could see no trace of disease on the plants. Yet on enquiry I find that few families took the trouble to grow this most delicious fruit.

Miscellaneous.—The Passion Vine (*Passiflora edulis*) grows freely, and is, indeed, wild in the bush.

Monstera deliciosa. Mr. Isaac Robinson has a plant or two.

Spanish or Sweet Chestnut (*Castanea vesca*). This does not bear well, although it forms a handsome tree.

Mulberry (*Morus nigra*) does well.

Walnut (*Juglans regia*) scarcely fruits.

The Cherimoyer grows well in Capt. Bates' garden, and this delicious fruit is occasionally consigned to Sydney.

The Mango appears to do fairly well. This valuable fruit tree should be well tested, the best varieties alone being planted.

The Cape Gooseberry (*Physalis peruviana*, Linn.) is very plentiful.

> "Many of the old roads, formerly used for bringing timber out of the woods, are grown up with Cape Gooseberry, *Physalis edulis*, which produces abundance of pleasant, small, round fruit, in a bladder-like calyx. This is eaten by the prisoners" (Backhouse, 264).

The Rose Apple (*Eugenia jambolana*) is thoroughly at home on the Island.

Captain Bates has a few tree-tomatoes (*Cyphomandra betacea*) which bear fruit in profusion.

The Date-palm does not appear to have been fruited on the Island.

The Coconut also flowers, but does not fruit.

The Pomegranate grows well.

The Date Plum succeeds fairly well.

SUGAR-CANE, COTTON, COFFEE.

Sugar-cane.—When Lieut. Govr. King reported on 18th October, 1796, this plant must have been well established on the Island. He introduced it at his first planting in March, 1788. He wrote :—

> "The Sugar-cane of which the different inclosures are made is extremely luxuriant and grows to the greatest perfection. Some sugar and a small quantity of spirits has been made. It is to the great quantity of sugar-cane that I attribute the success the inhabitants have met with in rearing such a number of swine."

Backhouse, p. 268, wrote :—

> "From the sugar-cane, the old settlers of Norfolk Island succeeded in making molasses, but they failed in obtaining sugar, not being aware that the addition of a little lime, or potash, was needful to make it crystallize. They also distilled rum, and injured themselves greatly by drinking it."

Downing, nearly twenty (20) years later, said :—

> "The sugar-cane is seen in many places growing luxuriantly, but quite neglected. The first settlers introduced the plant, and made rum of its juice. Under the subsequent regime this distillation was forbidden, and hence the cane became valueless."

The Sugar-cane is now only to be seen growing in a few places, being simply used for eating. It is certainly not a robust variety, and I know nothing of its quality. I do not suppose that Norfolk Island could compete with Fiji and the islands of many of the other groups in sugar growing.

Cotton.—I saw no Cotton, though this plant would flourish on the Island. The gathering of the crop might suit the temperament of the easy going inhabitants. If Cotton were re-introduced it should be under expert advice. Information would doubtless be forthcoming from the Colonial Office which is at present developing the Cotton crops of West Africa under the guidance of American experts. Lieut. Govr. King sowed three (3) cotton seeds in 1788, and under date 18th Oct., 1796, he reported :—"Cotton has also done well, although but little of it has been cultivated, as I am told it is a bad kind."

Downing wrote in 1851 :—

> "The Cotton-plant was once cultivated by Captain Maconochie with advantage. It is now wild, and overruns every part of the island to such an extent as to render the bush almost impracticable."

I think, however, this statement is overdrawn.

A statement (manuscript) made about 1843 says :—

> "The soil and climate of Norfolk Island are also adapted to the cultivation of Cotton (*Gossypium barbadense*), perhaps more so than any other, and as the labor attending it would be considerably less than that of maize, and the crop much more profitable, it is to be regretted that it has not been tried on a large scale. The produce of two rods, planted by Captain Maconochie on

the W. side of his garden at Cascade, was immense, and of the very finest texture and quality."

Coffee.—On 18th October, 1796, Lieut. Govr. King wrote:—

"Two weak coffee-trees, brought in 1791, are now healthy trees, bearing upwards of 20 lb. of berries each; from the luxuriance of their growth, great quantities might easily be raised."

Such was the beginning of Coffee in Norfolk Island.

If the Historical Records of N.S.W. be searched (*e.g.* vii. 7, *et ante*) it will be observed how again and again the authorities insisted on the prospective value of the Coffee plant to Norfolk Island. And in the partial evacuation of the Island in 1809 (vii. 273), talked of since 1803, Coffee was the only plant on Norfolk Island that appeared to concern the authorities.

A cultivated specimen (in flower and fruit) of *Coffea arabica* was depicted as tab. 91 of Ferd. Bauer's drawings of Norfolk Island plants. This useful plant was in the year 1819 taken to Tahiti from Norfolk Island according to Ellis (Polynesian Researches, i. 464, not 164 as stated, Endl., Prod. p. 61).

In 1835 Backhouse (p. 278) wrote: "I had also a letter from Alexander McLeay, informing us that the 'Friendship' would call here, for Coffee plants, on her way to Tahiti."

In 1851 Downing says, "The Coffee-plant thrives well and yields berries of small size and good flavour."

Captain Bates, a very old settler, has a large number of Coffee-trees in full bearing. Their growth is such that one cannot doubt for a moment that the climate and soil of Norfolk Island are very favourable to the development of this plant.

But it has been reserved to Colonel Spalding in late years to attempt to develop Coffee-growing into an industry. He commenced to plant in June, 1897, and last year cleaned half a ton of coffee; this season he anticipates a yield of three (3) times as much. He has 12,000 trees in various stages of growth, and the labour he has expended on his plantation may be fitly described as enormous. He has not only worked hard, but has carefully acquainted himself with the literature of the industry, and has also devised a number of ingenious mechanical contrivances for pulping,

&c. Col. Spalding spaced his trees 6 ft. × 6 ft. and latterly 6 ft. × 7 ft., allowing the extra 1 ft. for traffic. He has dwarfed his trees by heading them back; this affords the very great advantage of enabling the gathering of the crop to be carried out without the use of ladders, &c. He has good authority for the spacing of his trees as he has done; at the same time, without presuming to be a coffee planter, it seems to me that too close planting involves the risk of exhausting the soil and hence of opening the way to disease. However, the soil of Col. Spalding's plantation is marvellously rich, and I could see no trace of disease.

Minor Economic Plants.

Hovenia dulcis, "The Raisin Tree" (Rhamneæ). I saw one specimen.

Leucæna glauca, Benth. (Leguminosæ) is grown.

Inocarpus edulis (Leguminosæ). The "Vi" tree. There is a specimen from the Solomon Islands in the Melanesian Mission grounds.

Dolichos Lablab, Linn.; the well-known bean, often used for food.

Caesalpinia coriaria, Roxb. "Divi Divi," the celebrated tanning plant. The pods are used.

Indigofera Anil, Linn. This is a native of Tropical America. I found a few plants at Orange Vale, probably a remnant of an old experiment. It is cultivated in India as a source of Indigo, together with the better known *I. tinctoria* (Watt, Dict. Econ. Prod. India, iv. 383). The two species are closely allied. The pod of *I. tinctoria* is "nearly straight," and that of *I. Anil* is "sickle-shaped." See DC., Prod. ii. 225; Hook., Fl. Brit. Ind. ii. 99.

The Chocho (*Sechium edule*) flourishes well, and would grow out of bounds if permitted.

Downing wrote, "Cayenne pepper, manufactured from the pods of the Capsicum grown in these gardens, has a quality and flavour equal to any that can be obtained. It is in much demand." It is but little grown at the present time.

Nicotiana Tabacum. The Tobacco seems quite at home.

Peppermint is plentiful in some watercourses and damp grounds.

Tragopogon porrifolius (Salsify) is wild, and so is

Fœniculum vulgare (Fennel).

The Celery plant also is wild. Watercress is plentiful.

Introduced Plants.

List C.—Plants introduced for Cultivation, and which have got more or less beyond control.

CRUCIFERÆ.

Matthiola incana, R.Br. (?). The common Purple Stock has abundantly run wild near Emily Bay.

GERANIACEÆ.

Oxalis reptans, Sol., Endl., Prod. Norf. 128.

LEGUMINOSÆ.

Cytisus sp. Introduced as a hedge at the Melanesian Mission.

Lupinus sp. A purple-flowered species in Edward Buffett's paddock, and also in the Mission ground. The amount of seed is wonderful.

Vicia sativa, Linn. I have seen a specimen from the Island labelled *V. sepium*, Linn., which is, in my opinion, also *V. sativa*, Linn.

Vicia hirsuta, Koch.

CACTEÆ.

Opuntia brasiliensis, "A Prickly Pear" (bright yellow flowers, thin joints, two-spined). In Mr. Rossiter's land and at the Mission, near the gate. A plant near a building near the pier. I was told that the people have often tried to exterminate the Prickly Pear by cutting it and throwing it into the sea, but fail to exterminate it. They might be instructed how to exterminate it by means of a solution of arsenic in soda. I did not see much of the weed, and it could be got rid of readily enough.

LABIATÆ.

Salvia pseudococcinea, Jacq., Ic. Pl. Rar. t. 209, determined through the kindness of Kew. Wild and a great pest.

Mentha viridis, "Garden Mint," and *Mentha piperita*, "Peppermint," are both abundantly acclimatised.

AMARYLLIDEÆ.

Alstrœmeria (?) *pulchella*. Escaped from cultivation.

PONTEDERIACEÆ.

Eichhornia (*Pontederia*) *crassipes*, near Bloody Bridge. Introduced by Dr. Metcalfe, and not likely to be a nuisance.

Introduced Plants.

List D.—Weeds accidentally introduced.

PAPAVERACEÆ.

Argemone mexicana, Linn.
Fumaria officinalis, Linn.

CRUCIFERÆ.

Senebiera didyma, Pers.
Sisymbrium officinale, Scop.

CARYOPHYLLEÆ.

Cerastium vulgatum, Linn.
Silene gallica, Linn.
Polycarpon tetraphyllum, Loefl.

MALVACEÆ.

Malva rotundifolia, Linn., Endl., Prod. Norf. 136.

Sida rhombifolia, Linn. It is known on the Island as "Big Jack," after a Pitcairner of that name, who recommended it to feed goats and pigs.

LINEÆ.

Linum gallicum, Linn.

GERANIACEÆ.

Oxalis corniculata, Linn.
Erodium moschatum, Linn.

LEGUMINOSÆ.

Medicago denticulata, Willd.
Melilotus alba, Linn.
Trifolium minus, Sm.

Cassia lævigata, Willd. Known as "Acacia"; a very bad weed. It will die if eradicated, and the seed does not readily germinate.

ONAGRARIEÆ.

Œnothera biennis, Linn.
„ *tetraptera*, Cav. (?)

UMBELLIFERÆ.

Caucalis nodosa, Scop.

RUBIACEÆ.

Sherardia arvensis, DC.

COMPOSITÆ.

Ageratum conyzoides, Linn. Has the absurd name "Nightshade" on the Island. Widely distributed over the South Sea Islands.

Erigeron linifolius, Willd.
Siegesbeckia orientalis, Linn.
Galinsoga parviflora, Cav.
Hypochæris glabra, Linn.
„ *radicata*, Linn.
Taraxacum dens-leonis, Desf.
Centaurea melitensis, Linn.

PRIMULACEÆ.

Anagallis arvensis, Linn.

ASCLEPIADEÆ.

Asclepias physocarpa (E. Mey.), Schlt. My plant, the common "Cape Cotton" of Australia, and universally hitherto (I think) known by Australian botanists as *Gomphocarpus fruticosus*, R.Br., was determined by Rudolph Schlechter, when in Sydney, as above.

According to Schumann (Nat. Pfl. Fam.), the genera *Gomphocarpus* and *Asclepias* are quite distinct. I cannot find that *Asclepias physocarpa* was published, but we have *Gomophocarpus physocarpus*, E. Mey. Mr. Schlechter doubted that our Australian *G. fruticosus* is correctly determined, and the S. African specimen in the Herbarium has much smaller fruits.

Schumann says:—"*G. fruticosus*, (Linn.) R.Br., is spread over nearly all the warmer parts of the globe, doubtless everywhere introduced. It is a very variable plant, and also that *G. physocarpus*, E. Mey., differs from it only by the inflated fruits. There seems to be a difference of opinion between Schlechter and Schumann. Schlechter probably considers *G. fruticosus* and *physocarpus* to be distinct species, and Schumann as forms. There seems to be no doubt that our introduced plant is *not the true G. fruticosus*, and should be called either *G. fruticosus*, R.Br. var. *physocarpus*, or *G. physocarpus*, E. Mey.

SOLANACEÆ.

Solanum sodomæum, Linn. Known as "Poison" by the islanders. This is one of the worst pests on the Island, and it is very difficult to exterminate, since every bit roots. If an ordinance were passed compelling every landowner to keep his land clear much good would be done, and the Government would do something, of course, to keep Crown lands clear, but the effort would be worth making.

Solanum auriculatum, Ait. Universally known as "Tobacco" on the Island. This tall weed grows in incredible profusion and to a large size. I saw one 20 feet high and another with a head 25 feet in diameter. The circumference of the stem is sometimes considerable. Mrs. Bates told me of one she had measured which was no less than 44 inches, but I did not see any so large. It is, however, a weed which has some redeeming points:—

1. It is useful for firewood, and hence it might be judiciously checked. If it were entirely exterminated the islanders would have to fall back on the indigenous trees for firewood, and this would be regrettable.

2. It is a breakwind.

3. It produces much humus from its fallen leaves, and worn-out land is improved by allowing it to lie fallow with a growth of "Tobacco."

4. The Islanders make jam of the fruits.

5. Mrs. Spalding told me that the Norfolk girls use it as a scrubbing agent (with a little soap) for floors, tin-ware, pots, &c.

Nicandra physaloides, Gaertn.

Daturia stramonium, known on the Island as "Cranky."

SCROPHULARINEÆ.

Verbascum Thapsus, Linn. "Shepherd's Blanket" of the Islanders. On the (now) grassy top of Mt. Pitt and other places.

VERBENACEÆ.

Lantana Camara, Linn. The islanders made a law against Lantana, but it has fallen into neglect.

Verbena bonariensis, Linn.

LABIATÆ.

Salvia verbenacea, Linn.

Salvia pseudococcinea, Jacq.

Marrubium vulgare, Linn. "Horehound."

Stachys arvensis, Linn. The common weed known as "Stagger Weed" on the mainland.

PLANTAGINEÆ.

Plantago lanceolata, Linn.; *P. major*, Linn.

AMARANTACEÆ.

Amarantus viridis, Linn. (?). In bud only.

CHENOPODIACEÆ.

Chenopodium murale, Linn.
„ *ambrosioides*, Linn.

PHYTOLACCACEÆ.

Phytolacca octandra, Linn. "Poke-weed.'

POLYGONACEÆ.

Polygonum minus, Hudson.

EUPHORBIACEÆ.

Euphorbia Peplus, Linn.
Ricinus communis, Linn. "Castor-oil plant."

URTICEÆ.

Urtica urens, Linn. "A nettle."

IRIDEÆ.

Sisyrinchium micranthum, Cav.

LILIACEÆ.

Allium fragrans. Introduced with plants sent from Sydney.

GRAMINEÆ.

Briza minor, Linn.
„ *maxima*, Linn.
Poa annua, Linn.
Festuca bromoides, Linn.
Bromus sterilis, Linn.

Norfolk Island for many years employed over a thousand men in agricultural pursuits. These were succeeded (from Pitcairn) by 30 or 40 free men who simply could not keep in order the land that had been already cleared and broken up. There are at the present time only about a hundred working men on the Island, and they cannot be expected to keep the land as free from weeds as it undoubtedly was in convict times. When land is broken up for cultivation and then neglected, it is surprising how abundantly weeds take possession of it.

When ground on the Island is ploughed, the Cape Gooseberry (*Physalis peruviana*) first comes up abundantly, and this is succeeded by the Castor-oil plant. But these are not the worst weeds. The four following weeds occur in incredible profusion, and I may say that never in the whole course of my experience have I come across such a place for weeds as Norfolk Island. It affords a striking and sad example of the way in which an interesting endemic vegetation is becoming overwhelmed with introduced plants. The four principal weeds alluded to are :—

1. Tobacco (*Solanum auriculatum*).
2. Poison (*Solanum sodomæum*).
3. Acacia (*Cassia lævigata*).
4. Red Salvia (*Salvia pseudococcinea*).

Making every allowance for the islanders, I still feel that they do not make adequate efforts to keep the weeds in check. From all that I could gather, the islanders are something of fatalists in the matter of weeds. Even the cemetery at Emily Bay is overgrown in the rankest manner. There are weeds from the sea-level to the very summit of Mt. Pitt. In many cases they should be mown down persistently with a scythe, while in a flowering state; they should not be allowed to seed; then they should be ploughed in and sown with grasses. A few years of intelligently directed energy would make a marvellous difference in the stock-carrying capacity of the land and in its general appearance.

The rolling downs of the Island are park-like and marvellously beautiful, but they are marred by weeds. Still the beautiful appearance of well weeded park-land may be seen in part of the Mission Station, where, of course, there is much more labour available than in most parts of the Island.

As regards *Salvia pseudococcinea* (see p. 763), we have an object-lesson which the islanders would do well to ponder. If a plant once gets the upper hand, it may become a serious weed. Therefore, watch garden-escapes. Watch the plants which come up with a crop, the result of dirty seed. No amount of foresight can prevent these escapes showing themselves, but ordinary foresight can prevent their becoming a pest. Tobacco was doubtless originally introduced to beautify a home. Setting aside the weeds that have made most headway, by all means give attention to those plants that seem to be getting out of hand—incipient pests.

I understand that the eradication of weeds was at one time enumerated amongst the public works. But, as far as I can ascertain, very little weed-eradication is undertaken on either public or private account. The reason is that the people have so much land that at present they do not feel the deprivation of those areas which are lost to them through being rendered useless with weeds. But sooner or later, even in Norfolk Island, the pinch will come, and I think it should be impressed on the people that weeds, if allowed to seed, are spread through the agency of the wind, birds and stock. Something should be done, if only to prevent the weeds getting worse. The so-called "Poison" (*Solanum sodomæum*) is difficult to cope with. It bears enormous quantities of fruit, full of seed; and it should be eradicated and burnt. The so-called Tobacco (*Solanum auriculatum*) has some redeeming features, as already pointed out. The fruit of the Tobacco is palatable to birds, which drop the seeds everywhere, and it has taken on such an aggressive attitude that it is ousting the indigenous vegetation. Let the islanders by all means use it for fuel, but endeavours should be made to keep it in fuel reserves and not allow it to spread, unchecked, all over the Island. The best way to cope with these two weeds is to hoe or mattock them out when in flower. While I think the public spirit of the islanders should rouse them to do more weeding than they do, if only to improve the appearance of their beautiful island, I am of opinion that the weed-pests will only be adequately dealt with when there is a large accession of population.

Pests.—I made enquiry, as far as my opportunities permitted me, in regard to the insect and fungus pests on the vegetation. Norfolk Island does not appear to be cursed with very serious pests; at the same time some of them entail some loss on the Islanders, and, as years roll on, they will probably visit the crops with increasing severity unless approved means for combating them are seriously studied and adopted.

Reference to the original report of Lieut. Governor King in 1788 onward (see Hist. Rec. N.S. Wales, Vol. ii) shows how at the very beginning of settlement he was troubled with pests.

The American Potato Blight (*Botyritis infestans*) is said to be a recent pest, but it is already prevalent. The haulm withers right down in a day, and the potato is found to be spotted and then rotten. The Islanders are in the habit of saving their own seed and planting the same patch year after year. The remedies are fresh seed and fresh ground.

I noticed Mealy Bug on Oranges and Lemons, and Black Scale on Lisbon Lemons.

Curl-leaf was observed on some Peach trees.

Maize occasionally suffers from rust.

Onions are liable to rust, and also to the attacks of a scale insect.

Water-melons, &c., are liable to attacks by aphis.

Imported snails are very destructive.

Viscum articulatum, a native Mistletoe, is very destructive to Peaches, Oranges, and some other trees. The branch should be cut out between the end of its parasitic roots and the stem of the tree. The Islanders do not, however, appear to take any steps to check it.

On the other hand, the Coffee-plant is free from disease. There are no snakes, leeches or ticks. White ants are absent, and mosquitoes are very rare.

SUMMARY OF RESULTS.

Additions to the Indigenous Flora.

Norfolk Island presents few physical difficulties to the botanical explorer. The following appear to me to be new records for the Island; it does not include one species new to science.

PHANEROGAMS (46).

Clematis glycinoides, DC.
Ranunculus parviflorus, Linn.
Cakile maritima, Scop.
Frankenia pauciflora, DC.
Malvastrum tricuspidatum, A. Gray.
Linum marginale, A.DC
Pelargonium australe, Willd.
Geranium dissectum, Linn.
Glycine tabacina, Benth.
Rhodomyrtus psidioides, Benth.
Lythrum hyssopifolium, Linn.
Mesembryanthemum æquilaterale, Haw.
Apium leptophyllum, F.v.M.
Vernonia cinerea, Less.
Bidens pilosa, Linn.
Cotula australis, Hook. f.
Senecio lautus, Forst.
Sonchus oleraceus, Linn.
Picris hieracioides, Linn.
Wahlenbergia gracilis, A.DC.
Erythræa australis, R.Br.
Ipomœa Pes-Capræ, Roth.
Veronica calycina, R.Br.
Verbena officinalis, Linn.
Rumex Brownii, Campd.
Oberonia palmicola, F.v.M.
Microtis porrifolia, R.Br.
Colocasia antiquorum, Schott.
Cyperus rotundus, Linn.
Cyperus congestus, Vahl.
Kyllingia monocephala, Rottb.
Heleocharis acuta, R.Br.
Scirpus lacustris, Linn.
Scirpus riparius, Spreng.

Scirpus maritimus, Linn.
Carex inversa, R.Br.
Panicum effusum, R.Br.
Panicum sanguinale, Linn. var. *ciliatum*.
Paspalum scrobiculatum, Linn.
Andropogon refractus, R.Br.
Andropogon affinis, R.Br.
Microlæna stipoides, R.Br.
Echinopogon ovatus, Beauv.
Deyeuxia Forsteri, Kunth.
Dichelachne crinita, Hook. f.
Cynodon dactylon, Linn.

CRYPTOGRAMS (17).

Polypodium confluens, R.Br.
Adiantum diaphanum, Blume.
Pteris quadriaurita, Retz.
Blechnum discolorum, Forst.
Athyrium brevisorum, Wall.
Aspidium decompositum, Spreng.
Leptogium tremelloides, Linn.
Physma byrsinum, Ach.
Usnea barbata, Ach., and var. *florida*, Fr.
Ramalina leiodea, Nyl. var. *fastigiata*, Muell. Arg.
Ramalina farinacea, Linn.
Thelochistes flavicans, Sw.
Physcia confluens, Mtn.
Pyxine cocoes, Sw.
Patellaria versicolor, Fée.
Glyphis verrucosa, C. Kn.
Lentinus exilis.

The Algæ (new records) obtained on the shores of the Island I will not enumerate at this place.

2. The following list of species includes doubtful records and some plants worthy of further inquiry for various reasons :—

DOUBTFUL RECORDS AND SPECIES INQUIRENDÆ.

Clematis indivisa, Willd.
Clematis cocculifolia, A. Cunn.
Drimys Howeana, F.v.M.
Capparis nobilis, F.v.M.
Hymenanthera dentata, R.Br. (*H. oblongifolia*, A. Cunn.).
Boronia Barkeriana, F.v.M.
Eriostemon ambiens, F.v.M.
Eriostemon Beckleri, F.v.M.
Bosistoa euodiformis, F.v.M.
Pennantia Endlicheri, Reiss.
Streblorrhiza speciosa, Endl.
Metrosideros polymorpha, Gaud.
Mesembryanthemum australe, Sol.
Olea paniculata, R.Br.
Ochrosia elliptica, Labill.
Tylophora enervia, F.v.M.
Smilax purpurata, G. Forst.
Smilax glycyphylla, Sm.
Colocasia macrorrhiza, Schott.
Cyperus lucidus, R.Br.
Nephrodium remotum, Hew.
Phegopteris punctata, Bedd.

3. INTRODUCED PLANTS.

In my paper on the Flora of Lord Howe Island (these Proceedings, 1898), I furnished a separate list of the additions to the introduced plants recorded from the Island. At pages 746 to 769 (*supra*) will be found a list of the Norfolk Island introduced plants, and no good purpose will be served by making a separate list of the species first recorded by me, as most of them are now recorded for the first time.

The following species said to be indigenous were recorded solely by Professor Tate. He did not visit the Island, and I do not know who collected the specimens referred to.

Drimys Howeana, F.v.M.
Boronia Barkeriana, F.v.M.
Eriostemon ambiens, F.v.M.
Eriostemon Beckleri, F.v.M.
Bosistoa euodiformis, F.v.M.
Metrosideros polymorpha, Gaud.
Olea paniculata, R.Br.
Peperomia leptostachya, Hook. et Arn.
Malaisia tortuosa, Blanco.
Smilax glycyphylla, Sm.
Pandanus Moorei, F.v.M. (a name only).

SECTION ii.

EARLY GENERAL ACCOUNTS OF THE VEGETATION.

The following accounts by Captain Cook and Lieut. King refer to the primeval vegetation of the Island, and are interesting for that reason:—

"We continued to stretch to W.S.W. till the 10th, when at daybreak we discovered land, bearing S.W., which on a nearer approach we found to be an island of good height and five leagues in circuit. I named it Norfolk Isle, in honor of the noble family of Howard. It is situated in the latitude of 29° 2′ 30″ S. and longitude 168° 16′ East.

"We observed many trees and plants common at New Zealand, and, in particular, the flax plant, which is rather more luxuriant here than in any part of that country; but the chief produce is a sort of spruce pine,* which grows in great abundance, and to a large size, many of the trees being as thick, breast high, as two men could fathom, and exceedingly straight and tall. This pine is of a sort between that which grows in New Zealand and that in New Caledonia, the foliage differing something from both; and the wood not so heavy as the former, nor so light and close-grained as the latter. It is a good deal like the Quebec pine. For about two hundred yards from the shore the ground is covered so thick with shrubs and plants as hardly to be penetrated inland. The woods were perfectly clear and free from underwood, and the soil seemed rich and deep.

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* *Araucaria excelsa.*

"On the isle is fresh water; and cabbage palm, wood-sorrel, sow-thistle, and samphire abounding in some places on the shore, we brought on board as much of each sort as the time we had to gather them would admit. These cabbage-trees or palms (*Rhopalostylis Baueri*, J.H.M.) were not thicker than a man's leg, and from ten to twenty feet high. They are of the same genus with the cocoa-nut tree; like it they have large pinnated leaves, and are the same as the second sort found in the northern parts of New South Wales. The cabbage is, properly speaking, the bud of the tree; each tree producing but one cabbage, which is at the crown, where the leaves spring out, and is enclosed in the stem. The cutting off the cabbage effectually destroys the tree; so that no more than one can be had from the same stem. The cocoa-nut tree, and some others of the palm kind, produce cabbage as well as these. This vegetable is not only wholesome, but exceedingly palatable, and proved the most agreeable repast we had for some time" (A Voyage towards the South Pole, &c.," by James Cook. London, 1777, pp. 147-150, with a map of Norfolk Isle).

"Lieut. King describes this island as one entire wood, without a single acre of clear land that had been found when the 'Supply' left there, and says that the pine-trees rise fifty and sixty feet before they shoot out any branches. There are several other kinds of timber on the island, which, as far as he could examine it, was a rich black mould, with great quantities of pumice stone. The trees are so bound together by a kind of supple-jack that the penetrating into the interior parts of the island was very difficult." (Govr. Phillip in Hist. Rec. N.S.W., Vol. i. Pt. 2, p. 126).

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500 there is an account of the *Araucaria excelsa* of Norfolk Island.

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FERDINAND BAUER AND NORFOLK ISLAND.

The following brief notes concerning Ferdinand Bauer are taken from Lhotsky's paper. Bauer not only depicted the plants of Norfolk Island in a masterly manner, but he collected many plants, and his herbarium, with his drawings, enabled Endlicher to write his Prodromus. One extinct plant (*Streblorrhiza*) is now alone known from Bauer's drawings. I would that replicas of Bauer's drawings could, in the interests of science, be made for Australia. Australian botanists could thus be enabled to clear up some points.

He was appointed Natural History Draughtsman to the expedition to Terra Australis, commanded by Captain Flinders, of "H.M.S. Investigator." His salary was £300 a year, with rations for himself and servant. The E. I. Company having contributed £1200 towards the expenses of this expedition, the share which Bauer received enabled him to make his outfit as an artist very complete. It was further granted, by the Lords of the Admiralty, that all drawings executed, which were not required for publication in any work connected with the expedition, should be the artist's own property, as well as the specimens collected by him, except those that should go to the British Museum.

During his excursions from False Bay to Table Mountain, Cape of Good Hope, and those at King George's Sound, W.A., until the first arrival of the "Investigator" at Port Jackson, Bauer had completed, up to the 22nd of May, 1802, 350 sketches of plants, and 100 of animals, etc. On quitting the latter place for Torres Straits, he writes on the 20th of July that his collection then comprised seven hundred drawings, which he had left for safety in the house of the Governor at Sydney.

Lhotsky possessed two letters of his—one written from the east coast of New Holland, when the "Lady Nelson" left the "Investigator," and the other at the period when the latter vessel had been condemned, and Captain Flinders was on his way to England. In the latter communication, which is not dated, but probably written in the middle of the year 1803, Bauer states that between the period of his starting from and his return to Sydney, he had executed designs of 500 species of plants, and 90 of animals, the latter chiefly birds. He complains in this and former communications, that the wet state of the cabins in the "Investigator," by injuring his paper, had hindered the perfect execution of his drawings. Captain Flinders having decided to go back to England, Mr. Robert Brown and Mr. Bauer awaited his return in Australia; and during this period Ferdinand visited Norfolk Island, and spent eight months there, collecting those materials used by Endlicher "Baueri in colligendis stirpibus industriae, in desiccando dexteritati et divino plane in pingendo ingenio debetur" (Endlicher's Preface).

At length he determined to withdraw to his native land, taking with him his most extensive collections, drawings of more than 2000 species of plants, several hundred sketches of animals, a very valuable herbarium and collection of skins, the whole occupying 14 large cases, with which he set sail from England in August, 1814.

The liberality with which Ferdinand Bauer had been treated by the English Government, in whose service he had remained, finishing the plates illustrative of the expedition up to the year 1813, enabled him, on his return to Austria, to purchase a small house at Hitzing, near Vienna, adjacent to the large Botanic Garden of Schönbrunn. Here he worked very hard in executing and completing his drawings of New Holland plants and animals, as well as some plates of his illustrations, filling two large volumes with the former.

Bauer died on the 17th of March, 1826, in the 66th year of his age. The bulk of his collections was bequeathed to his legal heirs; but the two volumes of miniature paintings of Australian plants and animals he left to his brother Francis, by whom they were afterwards (1842) sold to Mr. Robert Brown. His herbarium and skins of animals and birds, with the sketches illustrative of them, were purchased for the Imperial Museum of Vienna; and a great many drawings, as well as copies of the Illustrationes, were still, in the year 1829, in the possession of his brother Francis at Vienna. I do not know what became of Francis' collections.

EARLY GOVERNMENT GARDENS.

Owing to the paucity of published records and to the break in continuity of settlement of the Island, it is very difficult to obtain details of the early Government gardens. The very beginning of cultivation is recounted by Lieut.-Govr. King in his official diary (Hist. Rec. N.S. Wales, ii. p. 556, *et seq.*).

From that modest record we learn that on Friday, 14th March, 1788:—

> "At noon finished delving and enclosing ye garden. Its size is 87 feet square; the soil very rich and deep. Began squaring it out and sowing ye seeds as marked in ye columns."

Following is a list of the first seeds, &c., planted:—

> "Potatoes, yams, turnips, onions, lettuce, spinage, parsley, cabbage."

On the following Monday, viz., 17th March, the following sowing took place, viz.:—

> "Potatoes, beet, early cabbage, cauliflower, cress, mustard, jibbrocoli, fennel, thyme, marjoram, shalots, sorrel, parsnips, parsley, carrots, corn sallad, lettuce, onion, Indian corn, French beans, rhubarb, 5 cocoanuts."

On that same day the proud entry was made:—

> "Turnips, radishes, cabbages and lettuces are out of ye ground."

The island was uninhabited prior to its discovery by Captain Cook, and doubtless these humble vegetables were the first ever grown on it by the hand of man.

On the 18th March he "sowed 3 cotton-seeds on ye top of ye hill." King carefully recorded progress in those early days, as the success of the plantings was of great importance, not only to the infant settlements, but also to Sydney, which had just been founded. The first maize (Indian corn) showed itself on Sunday, 23rd March, and on 30th March, doubtless as an extra treat for Sunday, he "cut some cress and mustard for ye people; left some for seed."

This first Government garden was doubtless close to the official township, and was known as "Arthur's Vale."

I have been permitted to make, through the courtesy of Mr. F. M. Bladen, a copy of a plan of Norfolk Island, entitled, "Plan of the Settlers' lots and the ground cultivated for the Publick on Norfolk Island, 1796." It contains "Lots of ground cleared of timber for the Publick use, green." There are three "green" areas, one at the settlement (the present township), a second called "Queenboro'," now known as Longridge, and a third called "Phillipburgh," now known as Cascades.

At an earlier date (19th March, 1794, Lieut.-Govr. King reported :—

> "Employed at cultivating Government ground :—At Sydney, 154 acres, 45 men. At Queensborough, 176 acres, 50 men. At Phillipsburgh, 42 acres, 18 men" (Hist. Rec. N.S.W. ii. p. 191).

pointing out that one hundred and thirteen only are employed at cultivation.

> "A great quantity of Government's maize remains to be got in, and the 376 acres belonging to Government are so much overrun with high weeds, owing to the constant rains, that it would require five times that number of men to get it in any tolerable state time enough for receiving the next season's seed, which should be sown in May" (*Op. cit.* Vol. ii., p. 187).

King, on 5th Novr., 1794, reported the number of "Gardeners at public garden, Arthur's Vale, for rearing plants and preserving seeds . . . 2"; and Gardeners at Queensborough for nursing of fruit trees . . . 2." This would of course refer to skilled labour only.

In a letter addressed by Mrs. Morrissett, wife of Col. Morrissett, Commandant at Norfolk Island, dated 5th March, 1830, to Mr. Fraser, Superintendent of the Botanic Garden, Sydney, she states :—

> "We have selected a beautiful spot for our garden, about 2½ miles from Government House, which we call the Orange Vale."

This was a fourth garden. Government House, Norfolk Island was, according to the same letter, occupied by Colonel and Mrs. Morrissett at Christmas, 1829.

Backhouse (p. 251) speaks, in 1835, of the Commandant's garden, which is situated in a beautiful hollow called Orange Vale.

The vale bears the name of Orange Vale to this day, but it has gone to ruin long ago. Approaching the Mission Station by the noble avenue of Norfolk Island Pines, one observes to the right, a second avenue of Pines descending to a gully. This is Orange Vale, but very few of the original plants (other than the Pines) are in existence now.

Backhouse goes on to say :—

> "Much of the land was formerly cultivated, but this is now overrun with the Apple-fruited Guava, and the Lemon, which were introduced many years ago, when the Island was settled, with a view to its becoming a granary to New South Wales. Grape vines, figs, and some other fruits have also become naturalised. In the garden at Orange Vale, coffee, bananas, guavas, grapes, figs, olives, pomegranates, strawberries, loquats and melons are cultivated successfully. Apples are also grown here, but they are poor and will not keep."

At p. 264 he goes on to say.:—

> "Accompanied by the Agricultural Superintendent, we walked to a stock-station, called Cheeses Gully, on the north side of the Island, where three men are placed in charge of some cattle, feeding on grassy hills, embosomed in wood, and partially overgrown with Lemon and Guava-trees."

I do not know whether the name Cheese's Gully is still in use.

There are the remains of the old Government Garden at the Cascades (Phillipsburgh) on Mrs. Young's land. It is a wreck of a garden now mostly under Sweet Potatoes, but some of the original trees are still in existence. For example, we have a huge Moreton Bay Fig whose surface or buttress roots spread out seventy (70) feet across. There are also huge Olive-trees, eleven feet at spread of roots; a *Pittosporum undulatum* thirty inches in diameter, and some very large Moreton Bay Chestnuts (*Castanospermum australe*).

I also noticed in this old garden, Yuccas, a Rose Apple, Pomegranate, a Coral-tree (*Erythrina*), a Guava forest, an edible Fig, *Arundo donax*, Peach, Mulberry, the Blue Guava (*Psidium Cattleyanum*), a Lisbon Lemon, Candle-nut tree (*Aleurites*), and a Cherimoyer. There are also the remains of a gardener's cottage, built of stone, and on its ruins and about the Indian Shot, the Passion Vine, and a tall Lima Bean are growing in the greatest profusion.

PHILLIP ISLAND.

On 2nd Decr., 1788, Lieut.-Govr. King wrote as follows :—

> "At 6 a.m. I went in the coble to Phillip's Isle, where I landed on a rock in Collin's Bay at half-past seven, and climbed up the hills, which I found a fine rich red clay. A valley in the form of a half-moon runs round the hills over Collin's Bay, and is, as well as the hills, wooded but not thick. I do not suppose that there are above 150 pine trees on the whole island. Most of the hills are covered with a thick entangled kind of reed (perhaps *Cyperus hæmatodes*, Endl., J.H.M.) which only wants burning to clear away 100 acres of ground, which would make a fine wheat land, if not too dry" (Hist. Rec. N.S.W., ii. p. 601.)

Allan Cunningham botanised on the Island (which by the way was termed Pig Island by Bauer, by reason of those animals being placed there), and he gave an account of his trip (London Journ. Bot. i. 113-120), which was sadly interfered with owing to his having been marooned there by his convict attendants. His account of the vegetation is the best that has been preserved, and is particularly valuable because the Island, though small, contained some endemic species, and because, as already hinted, the Island has, through the depredations of animals, been since reduced almost to the condition of a bare rock. Owing to the weather not being favourable I was unable to visit Phillip Island. Following is Allan Cunningham's account of the vegetation :—

"The interior presents some deep hollows, in parts densely wooded with small trees, and an underwood, chiefly of the thorny Caper bush (*Busbeckia nobilis*), bearing fruit like a green lemon, and very difficult to travel through" (*Op. cit.* p. 114).

"Of the plants, I have to remark that they were, with but few exceptions, the same as those of Norfolk Island. Among them were a species of *Hibiscus* (*H. insularis*, Endl.), which has a suffruticose, spinous stem, bore decayed yellowish flowers, appearing not to differ from a plant found at Port Macquarie. I collected flowering specimens of *Blackburnia pinnata*, not previously met with in that state, and also of *Capparis citrina*, A. Cunn. MSS. (*Busbeckia nobilis*, Endl.), and the ripe fruit of *Mimusops laurina*, A. Cunn. MSS. (*Achras costata*, Endl.), which being produced in abundance, afford considerable provender for the pigs. In the shades, I detected a dark, glossy, pinnated-leaved twiner; it appeared to be an undescribed species of *Clitoria* (*Clianthus Baueri*, A Cunn. MSS.") *Ib.* p. 115.

"After pushing our way through some brushes of Caper, [we] entered a thick, close wood, in which *Croton sanguifluum* (*Baloghia lucida*, Endl.), *Hibiscus Patersonii* (*Lagunaria Patersonii*, G. Don), *Myoporum obscurum*, Forst., *Blackburnia pinnata*, Forst., the large Piper (*P. psittacorum*, Endl.), and *Olea apetala*, Vahl, were very frequent. This latter I found in flower and young fruit, and was, therefore, fully enabled to establish its identity with Forster's plant, originally found by that botanist in New Zealand. The *Coccoloba australis* (*Polygonum australe*, A. Rich.) which I formerly detected on the sandy shores of the Bay of Islands, I also met with, in open situations, but not in fructification. On the southern and western sides of the Island, where more particularly I directed my walk, I observed on grassy spots, *Commelina cyanea*, R. Br., *Solanum nigrum* (?), *Plumbago zeylanica*, with the purple flowering *Dolichos* (*Canavalia Baueriana*, Endl.), bearing its pods, which are tricarinated on their upper edge. A few blighted trees of *Araucaria* stood detached from each other in open exposed situations, but not a single tree fern was met with in the deep gullies we descended, where only two species of *Filices*, so frequent on the large Island, were remarked" (*Ib.* p. 116).

Following appear to be the endemic species :—

Hibiscus insularis, Endl.

Streblorrhiza speciosa, Endl.

Solanum Baueriana, Endl., the fruit of which was described to me as "like a bright red elongated tomato."

Triticum Kingianum, Endl.

NEPEAN ISLAND.

A smaller island than Phillip, Nepean Island by name, is quite close to Norfolk Island and is grass-covered, with one solitary weather-beaten Norfolk Island Pine upon it. It is covered with grass and has no running water. It is about fifty feet high, a quarter of a mile long, and is of a horse-shoe shape.

Lieut.-Governor King wrote as follows concerning it on the 29th November, 1788:

> "At 9 a.m. I went out in the coble and landed on Nepean's Isle, which I found a lump of entire sand, which is kept together by a border of rocks. Notwithstanding the deep sand, this island produces near two hundred very fine pines" (Hist. Rec. N.S.W., ii. p. 600.)

EXPLANATION OF PLATE XXXVIII.

Dysoxylon Patersonianum, Benth. & Hook. f.

Fig. 1.—Epidermis paginæ superioris.
Fig. 2.—Epidermis paginæ inferioris.
Fig. 3.—Foliolum cum nervo laterali transverse sectum (160 × auctum).

a. Epidermis paginæ superioris; *b*. Hypoderma; c. Staurenchyma (Palissades); *d*. Pneumatenchyma; *e*. Epidermis paginæ inferioris; *f*. Cellulæ hypodermatis rostallophoræ; *g*. Cellulæ pneumatenchymatis; *h*. Cellulæ secretoriæ (resiniferæ); *i*. Fasciulus vasorum longitudinaliter sertus; *k*. Fasciculus vasorum transversim sertus; *ll*. Stomata; *mm*. Insertiones glandularum decissarum (L. Radlkofer).

NOTES ON THE GEOGRAPHY OF THE BLUE MOUNTAINS AND SYDNEY DISTRICT.

By E. C. Andrews, B.A.

(Plates xxxix.-xliv.)

Introduction.

The following notes are intended merely as an introduction to the geographical study of the Blue Mountain area. The salient points of the subject only are touched upon, the details being problems for future study. The deductions themselves also are suggestions only, needing more extended inductive studies for confirmation.

For a brief outline of the process involved in stream development, reference may be made to a paper by the writer* on "The Tertiary History of New England," in which the views of the American geographers are epitomised. To Hutton and Playfair, of England, the pioneering of this branch of study is due; but they lived a century in advance of their age, and stream development received little attention for a considerable period after their deaths. Sir A. Geikie recognised the importance of their methods more than half a century later, while J. W. Powell, J. S. Newberry, and others, as the result of exploration in the wonderland of the Western States of America, readily apprehended the natural succession of the forms induced by the agencies of gradation in elevated areas. To the untiring labours of Prof. W. M. Davis and his lucid interpretation of surface forms, modern geography owes probably its greatest impetus. As Prof. Huxley to the theory of biological evolution, so Prof.

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* Records Geol. Survey N.S. Wales, vii. Pt. 3, 1903, pp. 140-216 (and references).

Davis to geographical studies; and his numerous papers embodied in the publications of Harvard College, The American Journal of Science, the Geographical Magazine, the Geological Survey of the United States and other Societies are invaluable to intending workers in this field. The writer also desires to record the great help he has received from the perusal of a paper on "Shoreline Topography" by Dr. F. P. Gulliver* and one of the volumes in the Progressive Science Series on "River Development" by Prof. I. Russell.

In Australian studies very little attention appears to have been bestowed on the importance of appreciating the relative value of various operations known to occur in a cycle, although in a paper on "The Raised Beaches of the Hunter River Delta," by Prof. T. W. E. David and R. Etheridge, Jun.,† the later elevation is differentiated from the earlier and more important subsidence, and to each is assigned its proper share in the coastal topography.

Other workers‡ recognised the operation of contrary movements in the northern division of this State in Extra-Barrier Reef areas. A keen observer like Jukes,§ as the result of inductive studies, recognised undoubted signs of elevation along the Queensland and New South Wales coasts, but condemned his own deductions therefrom as premature inferences because apparently discordant with the conclusions arrived at by the great Darwin for the same place from "Barrier Reef" considerations. The Rev. J. E. T. Woods‖ also disputed the case for elevation, probably on the same grounds.

Other observers of note, however, like Prof. A. Agassiz, Dana, and Rattray,¶ untrammelled by prejudice, recognised the validity of the claims of elevation for North Queensland. Yet even workers like these appear to have overlooked what are, in the writer's opinion, the main lessons taught by the shore-line and coastal topography, as also the main criteria of subsidence and late elevation.

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* Proc. Amer. Acad. Arts Sci. xxxiv. No. 8, 1899.

† Rec. Geol. Survey, N.S. Wales, ii. 1890, pp. 37-52, pl. 3.

‡ J. E. Carne, Rec. Geol. Survey N.S. Wales, v. 1897, pp. 71-86.

§ Voyage of H.M.S. "Fly," i.

‖ Proc. Linn. Soc. N.S. Wales, v. 1886, pp. 187-189.

¶ For general references, see E. C. Andrews, Proc. Linn. Soc. N.S. Wales, 1902, Pt. 2, pp. 164-5.

In their discussions the idea does not appear to have been entertained of a dominant movement expressing "the algebraic sum" of various slighter movements, viz., that a region might, in a broad sense, represent the overshadowing influence of elevation or subsidence concomitantly with criteria of subsiding coast and shore-line movements in like or contrary directions. To a student of shore-line topography only, the eastern coast of Australia evidences the influence of late elevation at every turn, but to one who gets above these details of beach and coastal plain on to some high sea-cliff, the shore-line and associated areas are seen to be passing through a youthful stage of drowning on which a vibration of recent elevation has been imposed; while to the topographer viewing the coastal sweep from some commanding elevation like the Guy Fawkes "Look Out" in New England, the whole country is seen to be in a state of pronounced uplift interrupted recently (over restricted areas) by slight subsidence and elevation. Thus the high and widely trenched plateau which advances boldly into the sea in North Queensland points to a pronounced cycle of Tertiary elevation, since the initiation of which plateau dissection has advanced to the stage of maturity as regards the coastal area; the long saltwater valleys and boldly seaward advancing headlands, as also the numerous mountainous islands dotting the broad continental shelf, point to a very youthful minor cycle of coastal subsidence (following on well advanced marine erosion)* which flooded the old base-levelled valleys of the present "cañon cycle,"† and allowed of the establishment of the Great Barrier Reef on beds of late Tertiary age; while upon the same area a still later and comparatively insignificant movement or vibration of elevation has been imposed, criteria of the uplift existing as numerous raised beaches, tombolos and wide coastal plains backed up by high precipitous escarpments.

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* See also Prof. A. Agassiz, "The Great Barrier Reef of Australia," Bull. Mus. Comp. Zool. Harv. Coll. viii.

† Term adopted after Prof. W. M. Davis.

For the Sydney area we may represent the elevation which attained its maximum importance during the early part of the cañon cycle as 3000 feet, the fluctuating late subsidence as 200 feet,* and the joggle of elevation as 10 feet. The relative importance of each is thus appreciated. In a short time the thin veneer of coastal plain exposed by the elevatory vibration will vanish from the shore-line topography, while under the steady march of marine and subaërial forces the evidence of the epicycle of coastal sinking in late Pleistocene times, although more stable than that of the weaker elevation, will also be found to be short-lived. Yet after their disappearance the geographer will decipher the tale of the great late Tertiary uplift with the greatest ease, though doubtless scores of tremulous movements will modify the topography before the close of the cycle. Care should be exercised not to miss the main lesson in the insignificant details; shore-line, shore, coast, and plateau should be surveyed together, and the recent oscillatory movements discussed in the later portion of this paper may be regarded as ephemeral features which influence the grand issue in part only and depend for the very recognition of their existence on the evidence yielded by the associated sediments, as the occurrence of scaffold planks is inferred from the sight of a finished edifice.

As this paper is written mainly with the object of clearly differentiating between the various divisions of a cycle, let us emphasise the point still further by considering the philosophy of sedimentation as throwing light on the subject. Great systems like our Carboniferous and Permo-Carboniferous show immense basal conglomerates unconformably overlying finer beds. Other conglomerate and grit beds occur higher up in the series, though subordinate in importance to the great basal examples. Alternating coarse and fine-grained measures, and also bedded and lenticular limestones, occur in the inter-conglomerate spaces. The basal layers of boulders and pebbles argue a pronounced epeirogenic movement accompanied by folding which closed one series of cycles while inaugurating another. During the early stages of the initiatory cycle the torrential action (owing to increased stream grade) of the new streams resulted in great loss of boulders and pebbles along the shore, while the succeeding finer-grained masses evidence the pronounced subjugation of the continuous mountain system. The alternation of coarse and fine layers in vertical succession points to oscillations of movement—here a layer of grit indicating elevation, there a coarse-grained and cross-bedded sandstone evidencing rapid stream-movement, a bed of sandstone or lens of limestone illustrating calm conditions. The occurrence of conglomerates overlying fine sediment or growth as coal seams or mudstones implies the rejuvenescence of elevation succeeding pronounced erosion or slow subsidence and concomitant sedimentation; if the conglomerates be important, a new cycle is demonstrated. Nor must we lose sight of differential and accentuated movements. After elevation, subsidence oscillations act in the direction of diminished erosion and consequently finer sedimentation. A rapid rise after youthful sinking minimises the effect of the drowning. Thus from a consideration of such a system as the Permo-Carboniferous the existence of numerous large and small cycles is proved. Each vibration of movement resulting in a layer of sand or mudstones is overshadowed by the epicycle, each epicycle with its grits, &c., is dominated by the cycle, which in turn expresses but a fraction of the period.

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* More pronounced subsidence with equivalent sedimentation is indicated for North Queensland.

I desire here to thank Messrs. Dun, Morrison, and Murton for assistance and information supplied in the preparation of this work.

THESIS.

Several peneplains* were developed at various times at sea-level, and elevated successively to varying heights. The elevations were of the nature of broad vertical uplifts for the centre of the disturbed area, with gradual slopes east and west of the high central plains, the axis of uplift being meridionally disposed. The imperfect reduction of the old plateaus in their central portions permits of the deciphering of the relative amounts of erosion performed during the successive cycles of land-degradation, and thus affords physiographical criteria of the relative duration in time of such geological divisions as the Cretaceous and Tertiary periods.

A study of the Hawkesbury River shows that progressive stream to be the outcome of several periods of stream-revival, during which its original and unimportant consequent direction was succeeded by its present pronounced lengthwise course, as it adjusted itself wonderfully to the surrounding rock structures. The present cañons of the Lower Hawkesbury point to a rejuvenescence of the Pliocene stream, the river incising its way through the differential uplifts along its old course.

The youth of the latest uplift of importance is evidenced by the appearance of the present cañons. The influence of differential erosion on the rock structures is also well seen. An oscillation of subsidence in Pleistocene time is indicated by the conversion of the Pliocene(?) cañons along their lower courses into magnificent harbours, while subsequent stream-action and a very recent vibration of elevation accentuate such features as coastal plain-formations.

The commercial significance of the recent drowning and the piracy of the Hawkesbury by beheading of streams, with consequent diminishing of river competence to silt up the harbours, is well seen by a study of the coast.

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* One of these may hereafter be referable to "benching" in horizontally bedded strata.

THE PLATEAUS.

Standing on some eminence in or around Sydney and looking westward, a range of mountains is seen to present an almost unbroken sky-line to the observer. Here and there a flat-topped mass rises above the general level. The even sky-line represents the stretch of the Blue Mountain plateau, and the still higher table-topped hills count Mount Tomah, Mount King George, Mount Victoria and Blackheath among their number. If a trip be taken across the valley of the Nepean at Penrith to Glenbrook (600 feet above sea-level), it will seen that the surface gradually rises until a point is reached almost 3,000 feet above sea-level, when it will be found that numerous large flat-topped masses rise above this level. Crossing one of these mesas,* on which Blackheath and Mount Clarence are situated, a precipitous escarpment is observed to separate the upper and lower plain-like expanses. Thence the 3,000 feet level winds westward, being overshadowed by the mountains possessing subhorizontal summits. Various towns occur on this upland (3,000 feet), among which may be cited Orange, Blayney, Oberon, Hill End, Wattle Flat, Wallerawang and Lithgow. The plain-like expanses are not all at present co-extensive, but were the intervening gullies filled they would form a huge peneplain continuous in all directions and broken only in the central portions by large mountain masses. Around Lawson, Wentworth Falls, and the several towns just enumerated, these higher table-topped hills are common. Blackheath, Mount Victoria, Bell, Mount King George, Mount Tomah and the hills north and north-east of Wallerawang mark points on a higher level which rises some 400 or 500 feet above the lower plateau. Their total area is trifling compared with that of the 3,000 to 3,100 feet level, but were the wide intervening basins filled, they would in turn form another plain some 3,500 feet above sea-level in the central portions. Above these again numerous points occur, flat-topped or cone-shaped, which rise to a height of 4,100 to 4,300 feet above sea-level. These include the great flat-topped masses east of Bathurst known as the Stony Ridges, the Clear Creek Hills and Mount Horrible; while the Sunny Corner Hills, Mounts Lambie, Walker, Binda and the Jenolan Hills represent points rising to the same level, but more or less dome- or hummock-shaped.

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* A flat-topped hill rising above the surrounding plain.

Returning to a discussion of the 3,100 feet level, we find that east of a line running north and south in the neighbourhood of Mount Victoria there is a gradual decrease in slope to the sea, varied only by local differences. Thus to Sydney, from Lawson through Glenbrook, the general flat falls gradually to a height of 300 feet at the coast, broken, however, by the great valley of the Nepean at Penrith and the famous monoclinal fold and fault* running north and south through Kurrajong Heights. To the north and north-west of Sydney the general even easterly tilt appears to be bent upwards so as to present a gentle glacis to the metropolitan area. At Hornsby this slope has carried the land to a height of 600 feet above sea-level; beyond this point it spreads horizontally. Standing on the heights above the Hawkesbury River, near Berowra, the surface appears as a plain, surmounted by small flat-topped hills. Southwards from Sydney the 300 feet level rises gently for 40 or 50 miles until the 2,200 feet level is attained, beyond which the surface spreads as a great plain. Numerous small faults and folds will doubtless, hereafter, be found associated with this bent surface.

Throughout the Blue Mountains one finds tremendous gulches or trenches winding among the plateaus. These are bordered by huge parapets or ramparts of sandstone and shale, as much as 1,500 feet high in places. All the clefts end in V-shaped niches, into which waterfalls of great height precipitate themselves. Frequently the bases of the cañons are sunken 2,000 feet below the level of the plateau. Under the sandstone ramparts comes a steep slope of weaker material.

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* T. W. E. David, Journ. Proc. Roy. Soc. N.S. Wales, xxxvi., pp. 359-370.

Fig. 1 is a sketch section across the ordinary type of cañon. AA represents the high sandstone cliffs, BB the steep talus slopes. The floors of these valleys, as shown at C, are usually wide. A most interesting feature about them is the fact that if the ordinary slope of one of the sandstone beds as at A be continued across the valley it will coincide with a similar bed in cliff A. Similarly for the shale and sandstone slopes of B and B.* This fact of observation points to the obvious conclusion that at some previous period the sandstone and shale beds must have been continuous across the cañons.

Fig. 1.

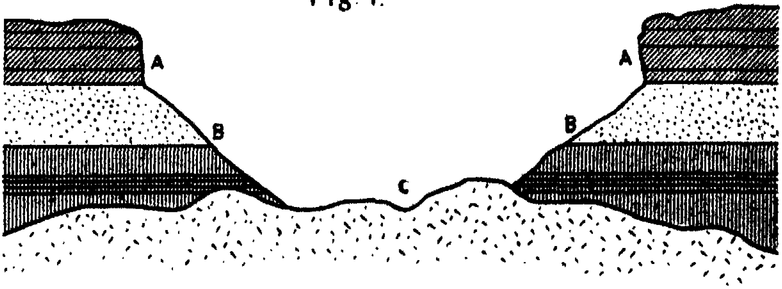

Fig. 1.—Diagram illustrating the formation of the Blue Mountain cañons.

Thus, from the foregoing paragraphs, it will be seen that by filling up all the hollows for each set of flat-topped masses† we shall obtain several plains rising one above the other; the highest being 4,100 or 4,200 feet above sea-level, and of relatively insignificant extent, being represented merely by peaks and a few mesas; the next 3,500 feet above sea-level, represented by long winding mesas; and a still lower one 3,000 or 3,100 feet in absolute height, and of much greater area than the 3,500 feet level. In the case of the 3,100 and 3,500 feet levels we notice that they slope gradually towards sea-level east of a line drawn north and south somewhere between Lithgow and Blackheath, and towards the interior west of a meridional line passing through Blayney or Orange. To the 3,100 feet level and its coastal slopes we propose the name of the Lithgow Peneplain; to the 3,500 (approximate) feet level the name of the Blue Mountain Plain.* To the 4,100-4,200 feet level the name Jenolan Plain seems appropriate from the occurrence there of numerous residuals of that old high-level surface. Above the Jenolan level very small hills are found, such as the Sunny Corner Mountain (Plate xxxix).

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* C. S. Wilkinson, "Mineral Products of New South Wales," 1882.

† Mesas.

Fig. *g* of Plate xxxix represents the relative slopes and mesas of each surface approximately.

More detailed observation may hereafter demand the fusion of the Blue Mountain and Lithgow Plains, with reference of the 3,000 feet level at Lithgow, Bowenfels, Rydal and in the neighbourhood of Mount King George to "benching" agencies. The great extent of the 3,000 feet surface, however, in the contorted Palæozoic rocks to the near west is against this idea of a common age for the two surfaces.

Thus it would appear that three peneplains have been developed near sea-level, and successively raised 700, 400 and 3,100 feet approximately above this datum line.†

From a study of the present disposition of the streams we should feel constrained also, even should the evidence of the mesas be withheld, to postulate at least a double cycle of erosion for the area under consideration, so marvellously are the streams adjusted to the rock structures. Reference in detail to this will be made in the proper place. Subaërial erosion and elevation thus appear to be the key to the formation of the successive plateaus.

At present the exact ages of these elevations and the cycles of erosion initiated thereby cannot be fixed. Each cycle, especially the earliest one, indicates an enormous period of time, and as must be obvious at once, each pronounced cycle such as we have evidence of in this area must be associated with a distinct period of sedimentation such as Tertiary (or Lower and Upper Tertiary), Lower and Upper Cretaceous, Jurassic, etc. Undoubted palæontological criteria of age are absent even for the latest movement of elevation resulting in the Lithgow peneplain, although a Miocene* age has been ascribed to the lower high-level plain of Eastern Victoria, which is probably co-extensive through Monaro with the Lithgow peneplain. The evidence as to the age of the Victorian plateau does not, however, appear satisfactory on biological grounds.†

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* From the more commonly known peaks in the Blue Mountains which form mesas of this level.

† Allowance must be made in these figures in the central areas for the incomplete reduction of a plateau to base-level.

It is possible, however, that the Lithgow peneplain was elevated by the diastrophic movement which initiated the earlier Tertiary sedimentation. The writer is inclined to assign this age to the uplift from a consideration of the advanced stage of cañon formation obtaining at present in the plateau surface. No plains have had time to form along the lower river courses, the Hawkesbury being confined to a narrow cañon even near its point of discharge into the sea. Nevertheless wide valleys have been excavated in still more western areas of weakness, while north of Sydney great valley-making is shown as along the lower and middle Hunter River, and the time necessary to excavate cañons in the resistant sandstone of Sydney is very great, and the amount of waste carried into the sea by the wholesale degradation of the Wianamatta Shales farther west is very considerable, being sufficient for the production of thick offshore deposits. The aspect of the Lithgow peneplain at the shore-line also evidences the far-reaching importance of marine erosion, to which a paper will be devoted in the near future. No movement of note has occurred since. Therefore an early Tertiary age for the last great uplift is very probable.

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* R. F. Murray, Progress Rep. Geol. Survey, Victoria, No. 5, pp. 96-111.

† H. Deane, Presidential Address, Proc. Linn. Soc. N.S. Wales, 1895, pp. 652-666.

It will be shown hereafter, however, that the great Tertiary uplift consisted of two or three distinct upward series of movements. The first one preceded the great basalt period, while another succeeded it, as may be seen by a study of the old river beds.

The formation of the Lithgow Plain occupied, however, a much longer period of time. The latest cycle, which we shall call the "cañon cycle," sufficed for the formation of small valleys only (save in the areas of shales), whereas the former cycle was productive of wide-spread plains continuous in many directions. The time occupied in the formation of the plateau was doubtless many times that comprised in the cañon cycle. Similarly for the formation of the Blue Mountain plain. The earliest formed plain, known as the Jenolan level, had been developed to old age, and indicates a cycle of gradation of such duration in time as to dwarf the times occupied in the succeeding cycles. From these considerations the writer would feel inclined to assign a Lower Cretaceous or Jurassic age for the Jenolan Plain, with an Upper Cretaceous or early Tertiary age for the Lithgow Plain.

Naturally in the study of levels like these, loss to mesas or "inheritances from previous cycles" of erosion during succeeding plateau cycles must not be overlooked. The remnants of one plateau are also attacked during the succeeding cycle of plateau reduction.

Let us imagine that, after a pronounced cycle of erosion in which the resultant mesas represent the most obdurate of the rock structures to erosion, a considerable movement of elevation ensues. Let us also suppose that the rock layers are horizontally disposed or gently inclined and that a soft layer which formerly lay below base level, and therefore beyond the reach of erosive activities, is now revealed by the elevation. During the new cycle the corrading streams will discover the weak layer, and rapid recession of both the weak and overlying strong structures will occur. Should a thick, hard bench occur beneath the soft layer, a terrace will be formed by the removal of the upper hard and soft layers until the underlying bench is cut through, the upper surface of the harder layer forming a wide terrace or esplanade. In this way the mesas of a former period may suffer great degradation in the earlier stages of a new cycle, their own powers of resistance to erosion being of no value when "sapping" takes place. Should the rocks be of massive homogeneous nature, as granite, or highly inclined hard varieties such as indurated slates and quartzites, then, provided the mesas are far removed from the incising action of the revived streams, the younger valleys may attain a considerable width before the residual blocks suffer any appreciable reduction. If the rejuvenated streams flow, however, at the foot of a large mesa, the mass suffers material reduction during cañon development. For example, before the elevation of a plain to form a plateau, an old sluggish river may in its lateral migrations be actually undercutting a large unreduced mass; on revival of the stream by elevation, a cañon quickly becomes the expression of the upward movement, and, as it broadens its valley, the monadnock suffers considerably even during the youthful stages of the cycle. Frequently mesas or buttes are favourably situated for their own preservation, being far removed from strong stream courses after elevation; their very existence, also, after the second cycle of erosion, implies their excessive obduracy of resistance to erosion; lateral corrasion, also, has but little effect on them, since the streams now have forsaken the plains for cañons sunken therein. Thus monadnocks (residuals) occupying the centre of elevation in areas of dense homogeneous rocks will suffer but little until the new cycle of erosion has progressed to such a stage that the main and tributary streams have lowered their courses to a point near base-level and lateral erosion ensues, with consequent broadening of the valleys and concomitant disappearance of the plateau or esplanade encircling the base of the monadnock.

In New England the writer has made special studies of the loss suffered by residuals at the hands of erosive activities. In the granite area of that district may be found remnants of at least four successive cycles of reduction. Only the most siliceous residuals of the earlier gradation periods survive to-day, the oldest as peaks, the next in point of age as ridges and subhorizontal masses. Well into the cañon cycle, however, the southern portion of New England was deluged with successive basalt flows.* Alternating hard and weak structures characterised the products of this volcanism; some of the flows were dense and offered great resistance to decay; others, again, by virtue of marked columnar structure and composition, were unstable as shales. The result is that even during such a brief geographical period as the later cañon cycle, the basalts have been "benched" back for many miles in the form of huge terraces, the upper portion of each surviving bench representing the surface (upper) of a hard lava sheet, the material lost to the volcanic rocks during this "terracing" being redistributed by the streams to form the major portion of the extensive "North-west" black-soil plains. The granite mesas and buttes to the north, however, have preserved their outlines in great measure during the whole of the cañon cycle, thus laying claim to being the "survival of the fittest." Loss there has been here decidedly, but confined to the development of shallow valleys by undercutting.

Before the present cycle has advanced to late maturity, the story of the great late Tertiary basalt deluge will survive only in a series of dykes, necks and stray volcanic knobs in the central area. Thus care must ever be exercised in differentiating between monadnocks and later imposed conditions such as recent volcanicity. In all the endurance of residuals is evident.

The enduring quartzites and hard Silurian rocks of which the remnants of the Jenolan Plain consist represent the central and most resistant masses in the Blue Mountain area to the attacks of erosion, for the Jenolan Plain itself evidences a reduction of hard and soft masses alike owing to the length of the cycle. Thus during uplifts which are in the main very similar, the centres of successive elevations being essentially coincident, the

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* The relative youth of these flows is demonstrated from the fact that they filled valleys excavated during the cañon cycle.

Jenolan residuals were always favourably situated as regards their own preservation. During the formation of the Blue Mountain peneplain, the process of "adjustment of streams to structure" had to be started again, but during the Blue Mountain cycle the repeated migrations of the streams had searched out all but the strongest structures. Then in the successive Lithgow Period the loss sustained by these Lambies* was trifling, such wear as they show being expressed by the formation of moderately sized valleys only, their position and hardness allowing of their preservation amid the general destruction. During the cañon cycle a series of deep valleys was carved in the shallow basins of the previous period, mainly as the result of pronounced elevation in forcing underlying weak structures high above sea-level. Examples of these cañoned mesas are the deep gorges at Jenolan and Kowmung (Kanangra) and the Macquarie River Valley, broad in the vicinity of Bathurst and contracted along its lower northern course in a gorge. In the case of the Macquarie River, a dome-shaped mass of granite (suggestively laccolitic in appearance)† is responsible for the weakness, the granite itself being resistant, but the weaker contorted Silurian slates overlying the boss were "stripped off" during the early age of the cañon cycle by the river in its lateral migrations, and these wanderings by discovering the continuation of the weaker rocks underlying the Devonian quartzites of the survivals from the Jenolan denudation, set up sapping, which operated so as to cause the rapid retreat of the precipitous escarpment of the Jenolan mesas at the Stony Ridges and Clear Creek.

THE PLATEAUS.

1. *The Jenolan Plain.*—Blue Mountain studies reveal the fact that at some stage in the earth's history—which we have named

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* The Americans employ the term "Catoctins" for the unreduced masses in the present cycle, and "Monadnocks" for those of a cycle previous to the present one. The writer proposes the name "Lambies" for the residuals of the third cycle, and "Spiribies" for those of the fourth, from Mts. Lambie and Spiriby, two conspicuous peaks of the Jenolan and Capoompeta levels respectively.

† J. C. Ross, Q.J.G.S., Vol. 50, 1893, pp. 105-119.

provisionally as Lower Cretaceous or Jurassic—a great plain was developed at sea-level. No idea can be formed in this locality as to the amount of movement initiating the cycle of erosion which resulted in the formation of this plain. Observations conducted in the dense siliceous granites of northern New England, however, show that the Bolivia Plain, consisting of flat-topped masses varying from 4,300 to 4,600 feet in height, resulted from the old age gradation of a plateau about 700-1000 feet in height which had been elevated at the commencement of the cycle. The Jenolan peneplain is approximately the same height as the Bolivia example and is probably its southern extension, although the intervening areas of soft Palæozoic strata have not been able to survive the erosive activities of successive cycles, and thus the relation can be inferred only from the general topographical similarity of the two areas.

The Jenolan period was one of long duration. Cañons had been cut in the plateau, mature valley systems developed; these in turn had expanded into wide plains under the action of lateral corrasion, until, at the close of the cycle, a few rounded eminences (Pl. xxxix., *a*) only of the most durable Silurian and Devonian rocks remained to attest to the existence of the old upland. The rivers even in flood time pushed loads of silt only beyond their mouths, and doubtless limestones were deposited in the clear water off-shore. Naturally during such a period of stable equilibrium, or rather one in which gradation and the algebraic sum of the elevations and depressions resulted in the formation of a plane near sea-level, the sea had encroached considerably on the land surface. Immediately after the initial elevation it had built up its off-shore base, then it had marched inland, destroying the bars and piling the waste to form the continental shelf. As the bars perished, the land was attacked, and the continental shelf grew at the expense of the coast. Large cliffs were doubtless in this case the expression of youthful sea attacks, but as the coast became subdued by subaërial agencies the cliffs of youth gave place to more subdued forms. As the sea encroached on the land, wave-base became progressively less deeply seated, the sea shallowing very gradually for considerable distances from land; thus wave-attack diminished in competency, and in the old age of the cycle the submarine platform and the Jenolan peneplain would almost merge into one another.

At the close of the cycle, then, the Jenolan Plain presented a generally even surface removed but slightly above sea-level (Pl. xxxix., fig. *a*) and diversified by gentle hills only; the coast consisted of enormous gently curving beaches unbroken by indentations. Sluggish rivers wandered over the plains, and near their mouths were deflected from their normal consequent courses by the dominant ocean current. The continental shelf was of considerable width, the sea deepening offshore for many miles at an excessively slow rate.

2. THE BLUE MOUNTAIN PLAIN (CRETACEOUS ?).

The further formation of the Jenolan Plain, of which Sunny Corner, the Stony Ridges, the Clear Creek Hills, Mts. Lambie, Binda and Walker are to-day the insignificant remnants, was interrupted by a gentle tilting motion which carried the old plain from sea-level on the east coast to a maximum height of 700 (?) feet in the central portions (Pl. xxxix., fig. *b*). A broad central plateau was thus formed, having down-folded east and west limbs. During the previous cycle, and also portion of the Blue Mountain period, the centre of Australia was occupied by a shallow sea, having a portion of its eastern shore in the neighbourhood of Moree, Narrabri and Dubbo. The new area thus secured may have considerably advanced the land eastwards. In that case it consisted essentially of a subaërial plain of denudation, with a marginal plain of marine erosion, capped by off-shore deposits. This capping of sediments would disappear early in the cycle. The Trias-Jura sediments were also exposed somewhat, and subjected to subaërial denudation, although it is probable they came, not into the sphere of pronounced central elevation, but occupied low-pitched east and west limbs only.

It has been suggested that the Blue Mountain Plain is one with the Lithgow level, and that the surface is one of sedimentation. The very broad valleys of Lithgow and associated areas, and the 3000 feet level of the western areas appear to be against this view. The writer also predicts differential erosion for the coastal and more inland areas.

The cycle of denudation which closed with the formation of the Blue Mountain peneplain involved the operation of long-continued and slowly acting forces. The streams wore the land down approximately to the old age stage, and broad plains like valleys were induced in all but the central areas of hard Palæozoic rocks (Pl. xxxix., fig. *c*). Compared with the Jenolan cycle, however, during which the central portions had suffered wholesale reduction, the Blue Mountain cycle was of short duration.

The sequential stages in the coastal topographical development after the uplift, resulted in a set of conditions very similar to those *obtaining at the completion of the Jenolan cycle.* The sea had, however, less time in which to accomplish its purpose. Thus the encroachment on the land by the sea was less pronounced than in the former gradation period, although the coastal and shore-line features were very similar.

UPPER CRETACEOUS (?) HISTORY.

The Lithgow Plain (The Plateau cycle).

With the close of the Jenolan and Blue Mountain cycles, the two longest chapters in the modern (geologically considered) topographical development of the Blue Mountain area are ended. The remaining chapters are, however, full of suggestion and interest, inasmuch as minor movements can be read easily in the recent cycles, while the main features alone are decipherable in the Jenolan and Blue Mountain periods, facility of interpretation, as regards surface features, being inversely proportional to the remoteness of time of any cycle of operations under consideration.

While yet the Sunny Corner and associated mountains remained to evidence the former proportions of the Jenolan Plain, another period of elevation occurred, this time, however, reaching a maximum of some 400* feet only in the central portions. The movement probably did not influence the streams materially, and they immediately commenced to cut narrow *cañons near to base-level* in their old wide plains. Fig. *d* of Pl. xxxix. illustrates the appearance of the tilted Blue Mountain and Jenolan levels. The rocks acted upon during this period were hard, consisting of slates, quartzites and sandstones similar to those around Sydney. Thus river-action was necessarily slow, especially in the final stages.

Stream-action continued for such a period that the eastern plateau as far inland as Wentworth Falls was cut down almost in its entirety to sea-level, mere hillocks being left thence to the coast, as may be seen to-day from the general level surrounding Hornsby and Berowra. In the central plateau, as also the western slopes, the hills had been attacked, and the plains on which Orange, Blayney, Oberon, Wattle Flat, Hill End, Rydal and Lithgow are situated, cut down almost to sea-level (Pl. xxxix., fig. *e*). Before the period closed the rivers wound and curved endlessly through wide plains of their own making. Every time they marched in serpentine course across the valleys they attacked the bordering hills, and widened their tracks. The channels in the upper portions were filled with excessively rounded pebbles, capped by sand and mud layers. These pebbles consisted of the hardest material only, such as quartz. These old streams, now buried beneath lava flows, evidence oscillatory movements of the plains, a fuller description of which is given in the author's description of New England.†

A period of volcanism is shown to be one of the closing events in this cycle.‡ Explosion craters were formed, and long streams of basalt poured thence out over the plains,* whereas the great lava plains in New England are suggestive of dyke-action. The Hawkesbury all this time had been developing itself at the expense of its neighbours. Originally it was an insignificant stream with a course almost due east to the sea. Thence, however, during the cutting down of the hills it discovered the slightly upturned edges of softer layers of the sandstone cap—places, for instance, in which whole areas of shale existed with sandstone, like that belt of country lying between Penrith and Picton.

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* This broad-bottomed valley near Lithgow, *400 to 500* feet below the Blue Mountain heights, has been assigned by some to benching.

† E. C. Andrews, "An Outline of the Tertiary History of New England," Rec. Geol. Surv. N.S. Wales, vii., Pt. 3, 1903.

‡ It is possible, however, that this will be proved to be referable to the later cañon cycle, as in the case of New England. Probably, also, many of the old lava sheets round Bathurst, etc., originated in dykes.

Straightway on the discovery it developed a lengthwise course therein, and, pushing its way south, it encountered other consequent or east and west streams. These being unable to cut their way into the surface as quickly as the Hawkesbury, owing to lack of water and load, had their head waters captured by its lengthwise course.

If observations be confined to the eastern portions of the elevated area, localities such as Berowra, Waterfall, Helensburgh, Loddon or Moss Vale, the Lithgow Plain appears to be as completely developed as the older peneplains. Studies conducted in the central areas, however, show that the age of the Lithgow cycle is insignificant compared with the older cycles. Final reduction of the central plateau is the criterion of excessive old age of a cycle of erosion. The Jenolan Plain satisfies this test of senility, and the discrepancy of age between its stage of development and the recent plateau is very pronounced.

THE CANON CYCLE (TERTIARY).

This period was initiated by pronounced and long continued uplift. This was the great elevation in late geological time (Pl. xxxix., fig. *f*). The Lithgow Plain was forced upward until it reached a maximum height of 3,100 feet above the sea in its central portions. The movement was not rapid, but so gradual as to probably occupy very many thousands of years in its completion and not to materially alter the Tertiary (?) river system.

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* *J. E. Carne, in litt.*

Very probably the old Hawkesbury River bed of Lapstone Hill belonged to the early cañon cycle, and the post-basaltic period of elevation revived the old stream which had previously been flowing over an area of but slight elevation.

The movement was not uniform, since we find on studying the original slopes of the surface (by connecting different portions of the Lithgow Plain across the gullies cut into them during a later period) that :—

1. At Sydney the general surface is 300 feet above sea-level.
2. ,, Hornsby ,, 600 ,, ,,
3. ,, Glenbrook ,, 600 ,, ,,
4. ,, Lithgow, Rydal, and Oberon ,, 3100 ,, ,,
5. ,, Hill End and Wattle Flat ,, 3000 ,, ,,
6. ,, Orange and Blayney ,, 2900 ,, ,,
6. ,, Clifton ,, 1200 ,, ,,
8. ,, Kiama Mountains and Moss Vale 2200 ,, ,,

By following the uppermost beds of the Hawkesbury Sandstone south of Sydney, a splendid idea of the gradual southward rise of the Lithgow Plain is obtained. The heights progressively obtained are, approximately, Sydney 300, Port Hacking 600, Waterfall 700, Helensburgh 900, Bulli Pass 1350, Robertson 2200, and Moss Vale 2200 feet. From all points the observer appears to stand on a limitless plain broken here and there (especially westward) by flat-topped hills.

Thus it appears that there has been an even vertical lift of 3000 feet between Orange and Lithgow, thence towards Sydney a gradual decrease in height, interrupted, however, locally by a large fold and fault,* while northwards and southwards of Sydney the coast has been gradually elevated to maxima of 600 and 2200 feet respectively. Sydney thus occupies the centre of a warped area.

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* T. W. E. David, "An important Geological Fault at Kurrajong Heights" (and references). Journ. Proc. Roy. Soc. N.S. Wales, xxxvi., 359.

From Rydal to Sydney, as also northwards of the latter place to Gosford and southwards to Illawarra, the upper portion of this great sweep of the Lithgow Plain consists of hard layers of sandstone, 900 feet thick at Sydney but thinning away rapidly thence to the north, west and south. The greater portion of the area between Sydney, Parramatta, Penrith, Glenbrook, Camden and Picton is composed of layers of soft sandstone and shales, thus forming an extremely weak spot in a very hard setting. Again, the hard cap of sandstone overlies other sandstones, sandwiched in with layers of shales, coal seams, etc., the whole forming a very weak structure when once the hard protecting cap has been removed. The rock structures west of Rydal are, in places, excessively strong, consisting of indurated Silurian slates and Devonian quartzites.

Fig. *e* of Pl. xxxix. represents the original appearance of the Lithgow Plain before the cañon cycle, with the flat-topped masses of the Blue Mountain and Jenolan Plains rising above it. The rock structure is also shown approximately, explaining the reason why the soft underlying shales were not attacked during this period.

Fig. *f* of Pl. xxxix. represents the uplift of this plain for 3000 feet above sea-level, and the relation of its structures now shows that at some little distance inland the weak shales and sandstones outcrop high above sea-level, while east of Glenbrook they are still below that level.

To digress slightly, it will be seen from a glance at the diagrams that the hills to the east and west of the central portions were never so large as those of the centre itself:—

(1.) Since the elevations were not so pronounced on the marginal or coastal portions as in the central areas.

(2.) Owing to increased river-action on the marginal areas (the whole of the drainage acting there) the result being that broad valleys are there developed by lateral corrasion, while the cañons of the central plateau are in their infancy.

Thus in all these cycles of gradation we should expect the mountains (unless extremely resistant) away from the central portions to disappear first, and great plains to exist in their place, while considerable flat-topped masses occupy almost the whole of the centre.*

To return to the discussion of the elevation, we note that the streams received a marked impetus therefrom. Instead of winding as heretofore sluggishly over the wide Lithgow Plain, they cascaded furiously to the sea and proceeded to entrench themselves in their old basins. They would also be confined to steep narrow cañons until they could saw their way through the hard overlying sandstone. As the consequent Hawkesbury cut its way through the resistant sandstone layer between Richmond and Broken Bay, so the soft layers of shale between Penrith and Picton were rapidly attacked by the lengthwise course of the river. It could, however, only cut downwards through the shales as quickly as the hard sandstone allowed the lower portion of the river to sink through its mass; thus the subsequent Hawkesbury amused itself meanwhile with meandering across the soft layers, scooping them out for miles in its migrations. The old plateau (Miocene ?) stream once flowed through Glenbrook, traces of which survive in the large conglomerates occurring there. The stream at that period doubtless ran at a point but slightly above sea-level, 600 feet below its present position. Traces of lower levels may be seen in the cuttings between Penrith and Glenbrook and on the large flat at St. Mary's.†

The cañon cycle was the period of exultation for the Hawkesbury. During the previous period it had searched out the weak spots then above sea-level and had developed its subsequent course in great measure, capturing the smaller consequent streams as they were unable to cut their cañons fast enough into the hard eastern layers. The Nepean appears to have been captured in this manner, and as we now know it is thus an *obsequent* stream.

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* E. C. Andrews, "An outline of the Tertiary History of New England" (and references). Rec. Geol. Surv. N.S. Wales, vii. 1903.

† W. B. Clarke, Sedimentary Formations of New South Wales. 4th Edition, and map.

The insignificant remnants of these so captured or *beheaded* streams, determined* in the previous cycle and modified in the cañon period, are known as George's, Port Hacking and Cook's Rivers and the greater number of the streams of the Illawarra coast.

Although, as was mentioned previously, (a statement to be amplified later) the very gradual uplift of the Lithgow Plain allowed the Hawkesbury to entrench itself along its former valley, it is natural to postulate decided stream-modifications for the cañon cycle, the following structures being competent to originate such modifications :—

(*a*) The fold and fault passing through Glenbrook and Kurrajong.

(*b*) The Wianamatta Shales of the Penrith-Picton area.

(*c*) The great warp-like elevation.

(*d*) The elevation of soft shales and other strata to a point considerably above sea-level.

The fold and associated fault have been described in some detail by Prof. T. W. E. David†. The author, from topographical criteria, is inclined to assign also a considerable age for these movements. By some the fold has been considered as the movement which drowned the coastal valleys in late Pleistocene‡ time. In these earlier discussions the evidence yielded by cañon cycle erosion appears to have been overlooked. Later observations§ prove the plateau to have passed through a great phase of degradation since the slow movements resulting in the fold and later fault. A considerable time appears evident for the movement because of the opposite pitches shown, illustrating the slow adjustment of coastal masses to one set of conditions and later reversal of the motion. The fold and fault appear to date back at least to the closing stages of the plateau (Lithgow) cycle. The establishment of the old plain stream, before the cañon cycle commenced, along a line fairly coincident with the general direction taken by the great fold, would at first sight appear to throw the age of the movement back well into the plateau cycle, on the ground that the fault line predetermined the river course rather than that the fault followed the stream. The Wianamatta Shales themselves, however, by their position appear competent to bring about such stream-deflection, and until further observations are taken along the line of folding and faulting the writer would be inclined to refer the age of the movements to the early cañon stage,* and assign the prime cause of the longitudinal course of the river to the instability of the shales and the prevailing rock strike. A fine problem for future study is thus opened up, viz., as to the relative age of river and folding, for faults rarely assume accidental parallelism with streams.

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* (*a*) From a consideration of their present channels, which are suited to their size. (*b*) Such admirable adjustment of streams to structure as shown here is the work of more than one cycle.

† "An Important Geological Fault at Kurrajong Heights, N.S. Wales." Journ. Proc. Roy. Soc. N.S. Wales, xxxvi. pp. 359-370 (and references).

‡ C. S. Wilkinson.

§ T. W. E. David, *op. cit.* p. 365.

Possibly the movement described by Prof. David† may be but a fresh slip on an ancient line of fault, but it seems absolutely demonstrated, however, that the fault scarp as seen to-day does not antedate the cañon cycle. River-development must be the criterion of age in the present state of our knowledge.

On the other hand, assuming the age of the folding to postdate the plateau cycle, it appears that the subsequent Hawkesbury had practically determined its course before the folding took place; thus the influence of the fold would not be marked, though its guiding action appears manifest in places.

The Wianamatta Shales are doubtless responsible in great measure for the lengthwise course of the river. On the great

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* Very probably the old Hawkesbury River bed of Lapstone Hill belonged to the early cañon cycle, and the post-basaltic period of elevation revived the old stream which had previously been flowing over an area of but slight elevation.

† *Loc. cit.*

Tertiary deformation they kept the stream within their area, while allowing great freedom of lateral movement.

The deformation which characterised the uplift doubtless modified some of the beheaded streams, as also headwater corrasion, although, as will shortly be shown, an excessively slow movement is evidenced for the elevation, thus reducing the competence of gravity as a deviating agent to a minimum.

The significance of a weak series underlying a hard shell beneath base-level during the plateau cycles, and raised thousands of feet above that datum surface in the cañon period, cannot be overestimated in stream modification. After the initial movements of uplift the upper streams kept gnawing their way back into the sandstone, forming deep cañons therein, with alcoves and recesses branching off from the main valleys, while waterfalls occupied the receding niches in the walls of masonry. Some little distance west of Penrith the gradual tilting of the surface had caused the underlying shales to be exposed by the incising streams. This discovery by the streams was the signal for a marked change in valley-making. Instantly "sapping" was set up, the soft shales were washed out by vertical and lateral cutting, the weight and great vertical joints of the overlying sandstone causing it to fracture and fall in wholesale manner, and a wondrous recession of the cañon walls took place, the V-shaped trenches opening out into very broad valleys. The upper cliffs now altered their steeply sloping attitude to great vertical ramparts (Pl. xl.). Yet along their lower courses the aggregated waters of the Hawkesbury streams are still forced to occupy steep narrow channels only, since the soft underlying shales here lie below base-level, and the cañon cycle is not of sufficient age to have allowed the streams to form wide valleys in the hard sandstone. Thus the upper streams of the Wollondilly, Cox and Capertee valleys occupy broad cañons, which open out lower down into the main stream by mere "gaps."* The Hawkesbury itself from Wiseman's Ferry to Sydney is a narrow gorge sunken into the Lithgow Plain and bordered by monstrous precipices. Every particle of material lost to the plateau by the formation of the mountain valleys has had to pass through the narrow defile of the Lower Hawkesbury to the sea.

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* For a fuller description of the philosophy of this mixture of "iron and clay" structures, see Memoirs of Geological Survey of N.S. Wales. Geology. Vol. 3, pp. 115-120 (J. E. Carne, F.G.S.).

Interesting in this connection, also, is the choice of course adopted by the Hawkesbury below Penrith, where its path is a cañon sunken in a plateau about 700 feet in height, while the short track to the sea from Penrith lies through a plateau only 300 feet above sea-level and composed in the main of soft shales.

This Lower Hawkesbury course, then, teaches four most important lessons:—

(1). That the river sawed its way through the coastal sandstone as the land was warped athwart its course, otherwise, instead of wandering 50 miles out of its way to attack a dense, hard plateau overtopping the surrounding eastern areas, it would have been forced under stress of gravity to take the line of steepest descent over the deformed area to the sea, viz., by way of Sydney, where the warping was but 300 feet above sea-level.

(2). The Hawkesbury is thus seen to be a revived stream, whose piratical tendencies had practically determined its present direction of flow in the preceding plateau cycle.

The wonderful "adjustment of streams to structure" (to employ a phrase used by Prof. W. M. Davis) in the case of this stream also points to at least a double cycle of subaërial erosion. A glance at any good map will make this clear to students of topography, especially if examined in connection with its piracy of the Shoalhaven River.

(3). The excessively resistant nature of the upper sandstone layer as compared with the underlying soft beds.

(4). The excessive youth of the cañon cycle as compared with the time occupied in the formation of the Lithgow peneplain, for in the plateau cyclé great areas of hard sandstone and quartzite had been cut away to sea-level, whereas cañons only express the loss suffered since the last great uplift. Untrained minds would be liable to be overawed by the tale of erosion as revealed by a review of the tremendous gulches of the cañon cycle and would see nothing phenomenal in the sluggish meanderings of a great river flowing over a broad plain at sea-level. Yet in the latter case the great plateau which gave birth to the stream has entirely vanished from the field, while the gorgeous cañons (Plate xli.) incised in the high lands to-day evidence the mere start of those activities which in the case of the plain have completely removed the towering mountains from the landscape, involving in its accomplishment the passage of untold years.

Another important lesson will be dwelt upon when discussing the origin of Sydney Harbour.

Sydney Harbour, Botany Bay, the Parramatta River and Port Hacking represent valleys cut in the sandstone by small streams.* They had no large bodies of water with which to develop broad flood plains, and contented themselves with excavating small branching valleys, broadening here and there, as at Botany and Botany Bay, where soft layers of rock and shale were discovered.

At this period, when the cañon cycle had progressed so far that the rivers presented essentially the same features as they possess to-day, (Plate xxxix., fig. *g*) the coast-line contained no harbours, for, to retrace our steps to the close of the previous plateau cycle, we shall see that the Tertiary uplift had operated so as to drown the old shore-line, and a long unroughened coast-line was initiated, the warping of the old plain causing the shore-line to take on the appearance of a huge embayment. The waves soon began cutting in close to the land, at the same time building in the waste below wave-base to form the continental delta. Cliffs were formed in the hard sandstone, and shoals and forelands then for a period protected the land. Afterwards the sea encroached still further, and great cliffs became the expression of the later attack of the sea on the coast. All this time the streams had quietly been cutting their way into the smooth uplifted plain, and from the first mild roughening of the surface they had gradually cut a host of valleys to base-level along their lower courses. The coast may at this advanced period of marine erosion be considered from two standpoints: firstly, as being minutely irregular; secondly, as being broadly very regular. The latter is the result of long-continued marine erosion, the former as being due to the action of streams on weak structures. A regular network of dykes exists in the Sydney sandstones, and these quickly became guiding lines for streamlets. The larger irregularities were the cañons of the George's, Parramatta, and Hawkesbury Rivers.

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* A study of their valleys points to the conclusion that they are rejuvenated streams in part, which had been beheaded in the plateau cycle.

A measure of the amount of shoaling for the shore of this period is supplied by a calculation of the amount of material lost to the mountains by the excavation therein of valleys such as those of the Hawkesbury and its tributaries.

POST-TERTIARY SUBSIDENCE.

After corrasion had reached the stage when the coast-line was regular and harbourless, and the numerous streams discharged into the shallow sea at the shore-line, the coast and shore began to sink very gradually, the sea trespassed over the sandy shoals and ran far into the drowned river valleys, converting them into magnificent harbours (Plates xlii.-xliii.). The movement was differential, and probably resulted in a slight elevation for the central areas. Rivers like the Hawkesbury had cut their channels down almost to base-level for long distances, yet the sea trespassed over such areas only. At various points along the shore-line or thereabouts an estimate can be obtained of the amount of drowning. At Peat's Ferry, where the river originally flowed at sea-level, the depth of the old valley floor below the present waterway would give the amount of subsidence at that point. The amount of drowning was probably about 200 feet in the neighbourhood of the shore-line.*

Sydney Harbour was formed by the drowning and *betrunking* of the Parramatta and Lane Cove Creeks. North and South

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* T. W. E. David, Journ. Proc. Roy. Soc. N.S. Wales, xxx. 1896, p. 57.

Heads were also converted into islands by the sinking, sea passages existing at Manly and Bondi. Brisbane Water, Broken Bay, Botany Bay and Port Hacking (Plate xliii.) were also formed by the drowning of the Hawkesbury, George's, and Hacking Rivers. The tiny cañons excavated in the weak coast spots by the streams were also converted into such inlets as Bronte and Maroubra.

This movement of subsidence is very youthful, since the main streams present the same appearance as they possessed immediately prior to the sinking, all the salient features of the valleys being determined in the earlier stages of the cañon cycle.

The movement appears to have been completed for a considerable period, as is evidenced by the characteristic *bay bars* of the coast between Port Hacking and Broken Bay. These *bay bars* will be more fully described when discussing the vibration of elevation which succeeded the oscillation of subsidence.

The rivers, however, still sent down their loads of sand and mud, and thus commenced to fill up the magnificent series of harbours formed by the drowning. The floods of the Hawkesbury silted up the lower salt-water channel, probably possessing, in the earlier stages of drowning, over a hundred feet of water. The dominant currents also swept the river loads and cliff débris into sheltered spots to form wide shoals.

The sinking of the shore-line allowed the sea to advance and rapidly undermine the cliffs. The movement is still youthful, as may be seen by a study of the cliffs between Port Jackson and Botany Bay, where the 250 feet walls end abruptly in 8 to 10 fathoms of water, thus showing that the formation of forelands and beaches in that locality is still distant in point of time.

RECENT ELEVATION.

After the partial shoaling up of salt-water arms like Broken and Botany Bays a slight movement or vibration of elevation ensued for the coast. In the Sydney district its vertical range along the shore-line probably did not exceed 10 or 15 feet. Its effect was to convert into dry land the shoals formed by the tide and current action in the previous oscillation of subsidence. The movement is extremely recent, even historically considered, since very little changes have been effected by the streams even on the raised flats (coastal plains) of incoherent sand. Probably 100 or 200 years would embrace the period of time since the movement.

A brief description of several portions of the shore-line of Sydney will illustrate the significance of the recent subsidence and much more recent uplift, and furnish an explanation of some of the most interesting topographical features of the sea-margin.

(*a*) *Dominant Wind and Current.*—Let B represent the dominant wind of any region, the dominant current is shown for the coast by the arrow C acting in the larger angle made by the course of the wind with the shore-line. This wind appears to be from the south-south-east, near Sydney, as evidenced by the general direction which the sand dunes of Kronulla, Lady Robinson's Beach and Bondi incline, or the prevailing inclination of the vegetation on the exposed headlands. Prevailing and dominant currents must not be confused. A current may set from the north for nine months in the year and yet not accomplish a tithe of the work accomplished by one acting fiercely from the south during the remaining three months, since work performed varies as the sixth power of the current velocity. Thus, if a current from the north perform a certain work, a current from the south moving at three times the velocity will perform 729 times the task of the weaker current. In this connection also must be considered the work performed by waves during severe storms.

Fig. 2.

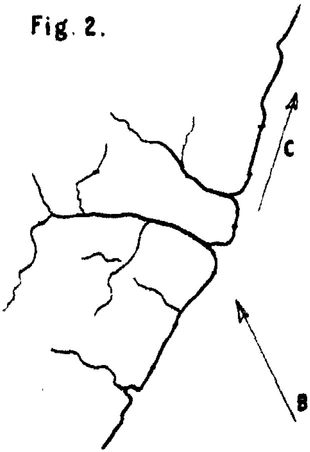

Fig. 2.—Diagram illustrating dominant wind and resulting dominant current.

(*b*) *Bondi.*—During the Post-Tertiary oscillation of subsidence South Head was converted into an island, a long passage connecting sea and harbour by way of Bondi and Rose Bay. The dominant along-shore current brought sand and waste lost to the Waverley cliffs into the gap; and a bar was quickly formed in the passage. The dominant wind has free play at Bondi, and the bar was quickly piled up above the waves by the heavy wind. Several old shore-lines were formed in this way as the bar grew seawards, with shallow troughs between the old beaches. Silting took place in the blocked passage on the harbour side, and in course of time a shoal was formed above water at low tide. The recent movement of elevation converted the shoals and shore-lines into dry land, and the dominant southerly wind piled up huge sand dunes on the former beach-lines and shoals.

It is probable that the sea is even now encroaching on its former work. In that case peat or allied material which once grew in the troughs between the successive shore-lines will be exposed on the beach during storms.

An interesting problem in structure is suggested by a study of Bondi. The underlying sand masses represent tide and marine current action; the long curving and now buried beach-lines represent wind-action; while the present masses of sand dunes under which the marine sediments are buried also are wind-blown. It may be possible that many areas in the Hawkesbury Sandstone may represent closely related sea and wind action. The writer intends to present a short note in the near future on the structure of the Triassic Sandstones of Sydney.

(*c*) *Manly.*—North Head also was converted into an island during the recent movement of subsidence. As for the present flat on which Manly is situated, it will be evident at once that its seaward aspect does not face the dominant wind, and that it is screened also in great measure from it as it sweeps across the harbour.

The heavy waves battered North Head, and produced great quantities of sand, which were swept northwards by the dominant current. In a minor degree also the gentler current from the north brought sand into the area under consideration. The Manly Channel formed a quiet spot where the currents had little power. Thus a great deal of the loss to the cliffs by marine erosion, and to the neighbouring land surfaces by streams, fell away from the centre current, and was deposited to form a shoal at low tide in the passage. Wave-action was not strongly marked. In course of time a shoal grew across the channel. At high tides the shoal would be completely covered, while in times of dead low spring tides the greater portion of the shoal would possibly be converted into dry land, and a narrow channel only connect sea and harbour together at the gap. The recent elevation carried the shoal some 10 feet higher, thus converting it into dry land, in which, however, a slight tidal channel would still exist. Marine erosion, dominant current, tide and elevation are thus the key to the origin of Manly.

The coastal plain continuous with the Manly flat had a similar origin, although here the dominant wind had some play, and the conditions are at times similar to those obtaining at Bondi. A couple of small creeks were dammed back by bay bars, and the lagoons thus formed were silted up in part. The recent vibration of elevation converted these into flats above the reach of the highest tides.

Such an island, as North Head, tied to the mainland by a sand bar or flat is called a "tombolo."*

Mr. L. Gundlach, Civil Enginner, informs me that Manly flat is composed of sand for at least 16 feet below the present surface, as revealed by sewage excavations.

(*d*) *Sydney Harbour.*—Had the Hawkesbury outletted in the vicinity of Botany Bay or Port Hacking, the enormous amount of débris carried out to sea in times of flood would be borne along shore by the dominant north current and deposited between the Heads in part as being a place of slight current. Thus the entrance to the Harbour would have been speedily blocked up as the Manly Channel has already become.

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* F. P. Gulliver, "Shoreline Topography." Proc. Am. Acad. Arts and Sci. xxxiv., 1899.

(2). The products of marine erosion will in time to come be borne along shore from the cliffs between Sydney Harbour and Botany Bay, and distributed to form a huge wing-like bar curving north and west from South Head. Beaches also will probably then exist under the cliffs.

(3). The streams which flow into Port Jackson are insignificant (owing to the former piracy by the Hawkesbury), and possess very little loads in time of flood. The action of these tiny streams will be to gradually silt up their own salt-water channels first, the time being far away when they can seriously affect harbour navigation.

(4). It will be remembered that the Hawkesbury developed a lengthwise course which, running north and south but a short distance west of Sydney, captured the headwaters of the other consequent streams. Here then we see the beneficial effects of this stream piracy on the commercial aspect of Sydney Harbour, since otherwise its streams would be possessed of considerable loads, the action of which would be to rapidly silt up the waterway.

Thus, briefly, it owes its importance to its steep off-shores, and the absence of considerable streams discharging either into it or into the sea immediately to the south.

(*e*) *Botany Bay.*—The huge sand flats and dunes skirting this bay are additional instances of the operation of forces discussed in connection with Sydney Harbour.

1. Kronulla Beach faces the dominant wind, and encroachment on the bay is shown by the rapid accumulation of huge sand dunes during south-east storms.

2. Lady Robinson's Beach is a magnificent example of a series of parallel bay-bars formed at the head of the bay. During the movement of subsidence the waste brought down by George's and Cook's Rivers, as also in large measure that swept into the bay by along-shore transportation, silted up the bay in part, and

allowed the heavy waves coming in through the Botany Heads to form a great sand bar about 1,000 yards inland of the present Lady Robinson's Beach. On this sand-bar formed by the heavy waves and about six miles in length the wind piled up sand to form a beach seaward of the original shore-line, and separated thence by a lagoon from 300 to 600 yards in width. The flat drained by the present Muddy Creek indicates the site of this old lagoon. As more material was swept into the bay, the bar grew off-shore, and another beach was piled up by the winds. Thus two great curving parallel bars were formed, separated by a long shallow trough. Many times this action was repeated until a whole series of sympathetically curving bars (beaches) with rounded tops and long rolling troughs were formed, and totalling about 1,000 yards in width (Plate xliv.). The crests are several miles in length, and the intervening troughs are from 6 to 15 feet lower. Doubtless peaty growths will be found in various places under the surface, representing marshy conditions of the inter-beach areas. The shape of the beaches indicates bottom action, the horns giving it a symmetrical concave aspect to the heavier seas, along-shore transportation being negligible.

Subsequently to this formation came the very late elevation of some 10 feet, and the series of sand bars and associated trough areas became dry land.

Another bar is now forming at a short distance off-shore. As time advances Muddy Creek will become dry land—in fact it has advanced partly to that stage from the lagoon marsh meadow by draining.

3. *Shea's Creek.*—This, as has been shown in detail by Prof. T. W. E. David and R. Etheridge, Junr.,* evidences the action of the recent oscillation of subsidence. Botany Bay, as shown by their map, formerly extended to Redfern, but shoaling ensued, and the recent elevation converted the shoals to dry land and mud flats. These flats represent the shoaling of quieter waters,

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*Journ. Proc. Roy. Soc. N.S. Wales, xxx., 1896, pp. 158-185.

contrasted with the conditions obtaining simultaneously at Lady Robinson's Beach.

(*f*) *The Hawkesbury River.*—Visitors to Gosford will remember that the train travels for nearly a mile and a half over a sand-flat as Woy Woy is approached. It is raised a few feet only above sea-level, is composed of sand, and contains many thousands of shells in its upper portions exactly similar to those occurring in the associated waters. The surface is not irregular like those sand heaps piled up by winds, or those formed by heavy waters and winds as at Lady Robinson's Beach. There are also, in this secluded spot, no waves competent to pile up sand-bars, nor streams capable of forming deltas high above sea-level.

When the oscillation of subsidence occurred which converted the Lower Hawesbury and its branches into salt-water bays, the loads of sand and silt still brought down from the Blue Mountains and Goulburn River District by the floods were partly swept out to sea along the main channel, and partly deposited by the lagging current in the sheltered arms of the river. Débris also was brought down from the neighbouring hills by the streams entering from about Gosford and Woy Woy, and rearranged by the tides to form wide shoals in the quieter spots, on which, as they approached the surface, whole hosts of shells grew. A slight movement of elevation then converted these shell-flats into dry land habitable by man.

A similar explanation accounts for the great flats skirting Lake Macquarie, and crossed on their western margins by the Newcastle trains.

(*g*) *Narrabeen, Rock Lily, Dee Why and Curl Curl Lagoons.*—Plate xliv., supplied by Mr. M. Morrison, illustrates the general appearance of this portion of the coast. To understand the successive stages of growth, we must refer to the activities in operation since the initiation of the cañon cycle. The general uplift which resulted in a warp for the Sydney area probably submerged the old coast-line of the Lithgow plain, as is evidenced by the peculiar character of the topography.* During the Lithgow cycle the rivers had pushed their loads off-shore, and the sea currents had built them into the smooth continental shelf below wave-attack. A wide sloping shelf was thus brought about at the close of the period, and the sedimentation on that shelf was more deeply buried by the warping. During the period between the birth of the cañon cycle and the recent drowning the rivers sent down huge loads of waste from the highlands, which were redistributed by the sea to furnish another coat to the already smooth off-shore deposits of the plateau cycle. At the same time the sea rapidly encroached on the coastal strip, the land retreating until huge cliffs were formed. A measure of the amount of this sea-attack is difficult to arrive at, as the land slope is irregular—now gently convex and now concave to the sky—and does not represent an even inclination seawards near Sydney.† In any case a considerable encroachment is indicated by an attempted restoration of the old slopes, probably exceeding 10 miles in width.‡

A large fault appears to be indicated for the Nowra District. On the south of the Shoalhaven River, the Lithgow Plain rises gradually from near sea-level to a height of over 2,000 feet some 30 miles in a westerly and south-westerly direction, while immediately to the north, across the Shoalhaven, rises the great escarpment of the Lithgow Plain some 2,000 feet in height.

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* If we assume that the warping induced elevation over the coast-line of the plateau cycle, then we are forced to one of two conclusions from the evidence of the topography:—

(1) Either the cover of marine (off-shore) deposits laid down on the shore of the plateau period and now forming the plateau around Berowra, Sydney, and Illawarra has been completely removed during the cañon cycle, and that too in certain places where such sediment would be particularly favourably situated as regards preservation; and moreover, from a consideration of such presumably stripped areas, the off-shore base must have been very regular.

(2) Or (assuming that the present coastal plateau is not of marine erosion) marine erosion in the cañon cycle has allowed the sea to considerably encroach on the elevated area, eating it back beyond the limits of the "plateau cycle" shore-line.

† *Ante*, p. 789.

‡ Consider, for example, the effect of marine erosion in the neighbourhood of Illawarra. Here the waves have cut the land down from nothing at the shore-line in early cañon cycle times to escarpments 2,000 feet in height near the present shore-line, the late elevation causing the sea to retreat considerably. Here again we have a measure of the great age of the cañon cycle.

By the removal of the land waste, the former smooth and later warped plain was roughened into valleys and ridges, reduction almost to base-level occurring along the lower stream courses. The recent subsidence converted these valleys to bays and harbours, as explained earlier in these notes. The sea dashing into bays of open type like the original Narrabeen and Rock Lily indents formed huge bars across their entrances, and impounded the inner waters to form lagoons. Bars‡ of the Narrabeen type show several aggradational lines of beach-growth according to the observations of Mr. M. Morrison and myself. In all cases *the influence of a dominant current from the south is inferred* from the occurrence of wedge-shaped bars attached by their bases to headlands forming the southern boundaries of the indents, while their northern ends are free, the lagoon outlets being in all cases jammed closely up to the headlands on the northern aspect of the lagoons. No dominant overlaps occur, however, bottom action being more pronounced. With the formation of the lagoons the force of the sea was able more rapidly to steepen the shore-slope instead of being fruitlessly expended in the smooth waters of an inlet. The waste brought down by the coastal streams and the sand blown over the bar by the dominant wind were now carried into the lagoons and redistributed by the tides to form shoals. Before complete silting up ensued the recent vibration of elevation occurred, and the old bays were transformed into huge flats, backed up by high broad belts of sand dunes (beaches), with small residual lagoons representing the still unshoaled portions. Sequential stages in the shore-line topography will be the complete filling of the lagoons, the formation of other bars and beaches further off-shore, and then the steady march inland of the sea with destruction of the present bars, beaches and lagoon-meadows, concomitantly with the gradual reduction of the neighbouring and distant hills by the forces of subaërial erosion.

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‡ The explanation of the cause of these bay bars will be dealt with in a future note on the submarine platform of New South Wales. Along-shore currents, combined with maximum wave action to form a steepening of the shore by accumulation, is doubtless the explanation.

All these points can be clearly made out by the observer from the Sydney cliffs or coastal plains, and thus are accessible to any metropolitan resident. The additional recommendation in their favour is that they may be appreciated by the "man who runs," and depend not for their understanding on laborious observation and skilled laboratory research. A wonderful charm is thus found to invest our characteristic scenery, since ability to trace the antecedent stages of the more prominent "facts of form" in a landscape cannot but conduce to the pleasure of contemplating sights at once noble and beautiful from the purely emotional point of view. The consideration of the control of population by the great uplift, the slight movements of later drowning, the profound cañons of the Upper Hawkesbury, the thievish propensities of that stream, the barren sandstone and mural sea-fronts of Sydney, also afford delightful cogitational exercises and illustrate the utter insignificance of man, the reflective, when opposed to natural activities.

DESCRIPTION OF PLATES XXXIX.-XLIV.

Plate xxxix.—Ideal Sections across the Blue Mountains during various Cycles.

Fig. *a*.—Jenolan Plain at close of Cycle.

Fig. *b*.—Jenolan Plain after elevation.

Fig. *c*.—Blue Mountain Plain at close of Cycle.

Fig. *d*.—Blue Mountain Plain after elevation.

Fig. *e*.—Lithgow Plain at close of Cycle.

Fig. *f*.—Lithgow Plain after elevation.

Fig. *g*.—Present contour illustrating insignificance of denudation during cañon cycle compared with that of Plateau periods.

Plate xl.—Govett's Leap, illustrating cañon-formation in alternating hard and soft layers of rock. Photo by A. E. Dyer.

Plate xli.—Valley of Grose, illustrating denudation during Cañon Cycle.

Plate xlii.—Pittwater (Lower Hawkesbury), illustrating drowned valleys. Post-Tertiary subsidence. Photo by A. E. Dyer.

Plate xliii.—View of the Lithgow Peneplain, showing the cañon cut by the Port Hacking River, and the later drowning of the same. Photo by A. E. Dyer.

Plate xliv.—Map of Sydney district, showing extent of recent alluvium, deposited during recent subsidence and exposed by more recent elevation. Drawn by M. Morrison.

The stippled area shows the area occupied by recent alluvium as mapped by Mr. M. Morrison.

The area indicated by hatching shows recent alluvium mapped by Prof. David.

The influence of a current from the South is shown by the characteristic disposition of the Narrabeen type of bar.

THE SLIME OF *DEMATIUM PULLULANS.*

By R. Greig Smith, D.Sc., Macleay Bacteriologist to the Society.

During the investigation into the etiology of the gum-flux of the peach and almond, a mould was isolated which, pending further examination, was called a dematium-yeast.* Upon saccharose media, it appeared as a raised glistening growth which eventually became dull. The culture had an appearance which suggested the presence of a small quantity of slime which was most noticeable when the growth was raised from the surface of the medium. It then appeared to be attached to the agar by a slimy substance.

Dematium pullulans has been credited with the production of a gummosis (? gum-flux) of the plum by Massee†, and Wortmann‡ has claimed that it causes a viscosity in musts and wines. It is known§ to produce a slimy or ropy consistency of unhopped beer-wort.

If the examination of the cultures of the mould should reveal the presence of a gum or slime, and if this should prove to consist of arabin or metarabin, then the rôle of the organism in contributing to the gum-flux of the peach, almond and other fruits would require consideration.

When time permitted, I investigated the mould and found that it undoubtedly was *Dematium pullulans.*

A quantity of the mould was obtained by growing it upon the surfaces of plates of saccharose-potato agar. Furthermore, flasks of saccharose nutrient fluid* were infected. After having stood in a cupboard for some months, these contained a number of films of a tough slimy consistency that had formed on the surface and had fallen to the bottom of the culture fluid. The fluid itself was somewhat viscous, although it could not be called ropy, and the viscosity was most pronounced when the medium contained chalk.

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* *Antea*, p. 129.

† Kew Bulletin, 1899.

‡ See Meissner, Cent. f. Bakt. 2, v. 232.

§ See Lindner, Cent. f. Bakt. iii. 750, and Betriebskontrolle in den Gärungsgewerben (1898), 218.

A portion of the agar-culture suspension was boiled with 1 % sodium hydrate. The emulsion contracted to a curd, leaving a clear fluid. The addition of alcohol to the fluid produced no precipitation, showing that dilute alkali was powerless to extract any gum carbohydrates from the growth. Another portion was boiled with 1 % hydrochloric acid. The suspended matter distributed itself throughout the acid in floccules and did not contract into a curd as with dilute soda. The acid filtrate after neutralisation gave a partly flocculent and partly stringy precipitate upon the addition of alcohol. The nature of the precipitate showed that a gummy body had been extracted by the dilute acid, and this solvent was accordingly used in the further treatment of the suspension.

The remainder of the suspended growths was diluted with water, and hydrochloric acid was added to make a 1 % solution, after which it was heated on the water-bath for some hours. The fluid was then strained through calico and filtered. Further treatment of the insoluble matter was found to be unnecessary, as everything soluble in acid and precipitable by alcohol had been removed. The filtrate, after neutralisation, was evaporated to small volume and treated with alcohol. A glutinous precipitate was thrown out of solution. The alcohol was removed by straining through calico and pressing the precipitate. Treatment with water showed that the solid consisted of at least two constituents, one soluble in water, the other insoluble. Both were repeatedly precipitated by alcohol from aqueous solution and suspension. Finally, both solution and suspension were tested and found to be free from reducing sugars.

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* Saccharose 50, peptone 5, potassium chloride 3, sodium phosphate 2, water 1000 grms.

The gum-like substances were boiled with 5 % sulphuric acid in flasks provided with aërial condensers for five hours. The soluble portion was completely hydrolysed by the acid, as was shown by the presence of reducing sugars and the absence of a precipitate upon adding alcohol to a small neutralised portion. The water-insoluble gum had not been attacked, and the boiling was continued for 20 hours. Still no reducing sugars could be detected. From the resistance to hot dilute acid and from the solubility in acid and alkali, it was probable that the slime would eventually be shown to be a pararabin.* The hydrolysis with concentrated acid was deferred.

The acid in the solution of the hydrolysed water-soluble portion was removed by barium carbonate. Traces of the precipitate that passed through the filter were eliminated with aluminium hydrate and the clarified solution was evaporated to small volume. Phenylhydrazine acetate solution was added, and the whole was heated on the water-bath for two hours. The osazones that separated out upon cooling the fluid were filtered off, moistened with alcohol and extracted with ether, which removed much impurity. The semi-pure osazones were heated with water, which dissolved a trace of galactosazone and a vitreous yellow substance comparatively easily soluble in hot water. The portion insoluble in water was dissolved in hot alcohol and cooled. There separated out a yellow crystalline precipitate which melted at 200° and which was eventually separated into galactosazone (m.p. 193°) and glucosazone (m.p. 205°). The cold alcohol filtrate from the osazone (m.p. 200°) upon evaporation yielded glucosazone.

The soluble substance extracted from the cultures of *Dematium pullulans* by dilute acid thus hydrolysed to galactose and a glucose.

These results were confirmed by the examination of a fluid culture. Much the same method of procedure was adopted in this case. The culture was evaporated to smaller volume and heated after hydrochloric acid had been added to make a 1 % solution. The acid filtrate was made alkaline, whereupon the difficultly hydrolysable carbohydrate was precipitated, while the easily hydrolysable constituent remained in solution. The latter was purified by repeated precipitation with alcohol, the former by solution in acid and precipitation with alkali until all reducing sugars had been eliminated. As in the former case, the soluble substance was completely hydrolysed to galactose and a glucose, while the insoluble carbohydrate was not attacked.

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* It may be noted here that Skerst (Cent. f. Bakt. 2, iv., 864) found that *Dematium pullulans* produced a characteristic skin of a gelatinous consistency with sugars such as saccharose, dextrose and levulose, especially when these were present in nutritive fluid to the extent of 10 %. He found that the slime or gum was not attacked by nitric and hydrochloric acids, zinc chloriodide, iodine, alcohol, petroleum-ether, ether, chloroform or potassium hydrate. It was attacked by concentrated sulphuric acid.

What the nature of the glucose was, I did not endeavour to determine. The object of the research was to prove the presence or absence of arabin or metarabin among the products of *Dematium pullulans.* The absence of arabinose among the sugars of the water- and alkali-soluble portion showed that neither of these gums is a product of the organism.

Remembering that Kossel* had shown that the nucleic acid of yeast when boiled with dilute hydrochloric acid gives a mixture of a glucose and a pentose, it occurred to me that the glucose and galactose that I had obtained had in all probability been derived from the nucleic acid of the fungoid nucleoproteid. That they had been so derived was shown by the absence of carbohydrates, soluble in dilute alkali, in the viscous filtrate from a culture of the mould in a saccharose-peptone fluid which contained chalk. It can therefore be accepted that the glucose and galactose had been derived from the proteids of the *Dematium* and should not be considered as having been derived from the slime products of the organism.

Upon finding that the constituent insoluble in dilute alkali could not be hydrolysed, the dilute acid solution was evaporated down upon the water-bath until it charred. At this stage it showed traces of reducing sugars when tested with Fehling's solution. The dark-coloured liquid was diluted with water to the original volume and boiled for some hours under an aërial condenser. After removal of the sulphuric acid and concentra-

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* Lafar, Technical Mycology II., i., 162.

tion of the fluid, the osazones were prepared. The crude osazone, after treatment with ether, yielded a yellow crystalline constituent soluble in warm water, with a melting point of 160° (arabinosazone) and another which melted at 194° (galactosazone). The quantity of the former that was obtained was just enough to determine the melting point. The latter had the characters of galactosazone. When these results are considered in conjunction with the solubility of the carbohydrate in acid, the insolubility in dilute alkali and the resistance of the hydrolytic action of boiling 5 % sulphuric, it is apparent that the carbohydrate is a pararabin.

The pararabin is a kind which when once in the insoluble condition is not easily made soluble. As obtained by growing the mould upon solid media, the slime did not dissolve to any extent upon digesting a suspension of the culture in the autoclave, and on this account dilute acid was used as a solvent. In contrast with this behaviour, the pararabin formed by *Bact. pararabinum* was easily dissolved by the autoclave treatment. Still some of the Dematium slime is dissolved, and it is probably simply a question of time or of temperature in order that the carbohydrate may be completely altered to the soluble modification. Upon the evaporation of most of the water, a solution of the slime became gelatinous. Drops of this gelatinous solution when tested with drops of reagents gave white curdy precipitates with basic and ammoniacal lead acetate; faint white precipitates with baryta water, silver nitrate and phosphotungstic acid; pale blue precipitates with Schweitzer's and Fehling's solutions; and no reaction with neutral lead acetate, ferric chloride, copper sulphate, iodine or the alkalies.

Summary.—A race of *Dematium pullulans* was separated from specimens of the peach and almond affected with gum-flux. When grown upon or in media containing saccharose, it produced a pararabin. Neither arabin nor metarabin was obtained, and therefore *Dematium pullulans* has no influence in the production of the gum-flux of these fruits.

NOTES AND EXHIBITS.

Dr. Greig Smith recorded the occurrence of a race of *Bact. eucalypti*, Greig Smith, in the manna of *Eucalyptus punctata*, DC., exhibited by Mr. Fletcher at the previous Meeting. The race was weak, inasmuch as it did not liquefy gelatine, and produced a small proportion of gum levan. He also exhibited cultures of *Dematium pullulans* and specimens of the pararabin slime in illustration of his paper.

Mr. Stead exhibited a spirit-specimen of the beautiful and interesting "Glass-rope Sponge," *Hyalonema mirabilis*, from Japan.

Mr. Maiden exhibited a number of botanical specimens, and a series of photographs of Norfolk Island, in illustration of his paper.

Mr. J. J. Walker exhibited *Gempylodes tinctus*, Olliff, a rare and curious beetle of the Family *Colydiidæ* (type from Lord Howe Island, in Australian Museum), found at Otford (Illawarra), apparently parasitic on a wood-boring weevil (Subfam. *Cossonides*), to which *Colydium* sp. (?), also exhibited, was attached. Also a specimen of a small beetle from Otford, very closely resembling *Phyllotreta vittula*, Redt., (Fam. *Halticidæ*); this is very destructive at times to crops of turnip, rape, cabbage and other cruciferous plants in England, and is known, in common with two or three very similar and equally destructive species, as the "Turnip-flea;" in all probability it is a recent (and undesirable) importation.

Mr. Froggatt exhibited specimens of parasites and hyperparasites of the Brown Olive Scale (*Lecanium oleæ*) bred from parasitised specimens of the latter, recently received from Mr. C. P. Lounsbury, Entomologist, Cape Town. The true parasite, *Scutellista cyanea*, Motsch., has been found to be a very valuable aid in destroying this destructive pest in Ceylon, Italy and South Africa, but it again has many parasites which devour its larvæ, among them several members of parasitic wasps (*Tetrastichus*). He also showed some small flies and a Psocid among the specimens collected from the contents of the package.

Mr. Fred. Turner exhibited and offered some observations upon the following plants:—(1) The "Yellow-rattle" of Europe (*Rhinanthus crista-galli*, Linn.), an introduced plant more or less parasitic on the roots of grass and other herbage, which has recently appeared in certain pastures bordering the Hawkesbury River; (2) two European species of *Medicago* (*M. tribuloides*, Willd., and *M. minima*, Willd.) from the neighbourhood of Warren, where they had not previously been observed; and (3) the European *Papaver argemone*, Linn., and *Ranunculus muricatus*, Linn., from Tulcumbah, Liverpool Plains, not seen there before. The seeds of the four last-named plants are supposed to have been introduced with imported stock-food.

Mr. Jensen showed under the microscope (1) sections of a specimen of coal from Newcastle, N.S.W., given to the exhibitor by Mr. S. R. Mort, the sections proving the matrix to consist almost entirely of sporangia and spores; and (2) slides of Foraminifera and glauconite granules from the Palæozoic Formation of Jutland, Denmark.

Mr. Andrews exhibited a large model of an ideal section of the country between Orange and Sydney, showing the characteristic physiographical features, in illustration of his paper.

Mr. Fletcher showed a series of fresh flowering specimens of the beautiful plant *Epacris impressa*, Labill., illustrating the well-known variability of this species in respect of the colour of the flowers (from pure white through various shades of pink to red), and in the length of the flowers. The specimens had been most kindly forwarded by post from Pambula, N.S.W., by Mrs. Forde. As far as known, the Pigeon House Mountain seems to be about the northern limit of the species.

WEDNESDAY, OCTOBER 28TH, 1903.

The Ordinary Monthly Meeting of the Society was held in the Linnean Hall, Ithaca Road, Elizabeth Bay, on Wednesday evening, October 28th, 1903.

Professor T. W. Edgeworth David, B.A., F.R.S., Vice-President, in the Chair.

Mr. G. W. KIRKALDY, F.E.S., &c., Department of Agriculture and Forestry, Honolulu, H.T., was elected a Member of the Society.

The Donations and Exchanges received since the previous Monthly Meeting, amounting to 3 Vols., 48 Parts or Nos., 4 Bulletins, and 1 Report, received from 27 Societies, &c., were laid upon the table.

THE GUM AND BYPRODUCTS OF *BACTERIUM SACCHARI.*

BY R. GREIG SMITH, D.SC., MACLEAY BACTERIOLOGIST TO THE SOCIETY.

In May of last year I read a paper before the Society upon "An Ascobacterium from the Sugar-cane, with Notes upon the Nature of the Slime."* The chemical notes regarding the slime were of a preliminary nature, and showed that the slime yielded a carbohydrate containing some nitrogenous impurity. Under certain conditions of preparation, the carbohydrate, which may be called a gum, was soluble in water and was readily converted into an insoluble modification by treatment with alcohol. The gum yielded furfural on treatment with hydrochloric acid, and gave a reducing sugar upon hydrolysis with dilute sulphuric acid. The osazone with the melting point of 153° which was obtained was, in view of my later researches, probably contaminated with a substance that reduced the melting point. At that time methods for the purification and separation of mixed osazones had not been described, and the difficulty of obtaining the slime in quantity had militated against my devising a method for the purification. Since then, however, I have so improved not only certain media for growing gum-producing bacteria, but also the methods for purifying and separating the osazones of arabinose, galactose and glucose. A small quantity of carbohydrate is now sufficient to enable a determination of the products of the hydrolysis to be made with a considerable degree of precision. To complete my work upon *Bact. sacchari*, I determined to reinvestigate the slime.

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* These Proceedings, 1903, 137 *et seq.*

Experiments with other slimes had led to the preparation of a medium containing potato juice 100 c.c., glycerine 50 grm., tannin 3 grm., agar 20 grm., and tap-water to make a litre. A preliminary sowing of *Bact. sacchari* upon a plate of this medium showed that it produced a luxuriant slime which did not adhere to the medium. In view of this favourable result, large plates of the medium were sown with the bacteria. The most convenient size of Petri dish measures 15 × 2 cm., and easily holds 100 c.c of agar medium. When larger dishes are used there is always too much condensation of moisture upon the cover. The drops of water that gather fall into the solidifying medium which is softened locally and the soft agar is removed with the slime. The infected plates were maintained at the laboratory temperature (18°-20°). Upon the fifth day 135 c.c. of a thick slime were removed, two days afterwards another 58 c.c. were gathered, and on the tenth day another 20 c.c., making a total of 213 c.c. of slime which had been obtained from a litre of medium.

The slime was freed from glycerine and other matters by precipitation with alcohol, resuspension in water followed by a second treatment with alcohol. As the slime was acid and coagulation with the alcohol was not complete, it was nearly neutralised with potassium hydrate. Neutralisation to phenolphthalein or to litmus caused a darkening of the slime from the tannin contained in it, so care was taken to maintain the slime just sufficiently acid to prevent any prominent change of colour. The slime was rather deficient in saline matter, as was evidenced by the alcohol producing a "milk," but the addition of potassium chloride and the warming of the alcoholic fluid induced a complete coagulation.

After the second coagulation, the slime was tested for reducing sugars, and as none were found the coagulated slime was treated with water until a homogeneous emulsion was obtained. This was heated on the water-bath to expel the bulk of the small quantity of alcohol that had adhered to the coagulum. The emulsion was then heated in the autoclave at a pressure of three atmospheres for fifteen minutes. This treatment produced a separation of the slime into a comparatively clear supernatant liquid and a sediment. The sediment was treated with water and again heated in the autoclave. The second heating had apparently brought all the remainder of the gum into solution, for the insoluble matter was not at all slimy. The gum solutions were clarified with a little aluminium hydrate and, after filtration, concentrated by evaporation. About 100 c.c. of a thick, viscous, transparent gum mucilage were obtained. This was adhesive, and firmly fastened paper to glass.

Upon testing drops of the thick gum mucilage with drops of reagents upon a glass plate as recommended by Maben,* basic lead acetate and ammoniacal lead acetate gave white curdy masses, ferric chloride gave a translucent brownish clot, barium hydrate thickened the mucilage, Schweitzer's reagent produced a gelatinous slime, dilute iodine gave a reddish tinge; no reactions were obtained with borax paste, copper sulphate, neutral lead acetate, milk of lime, aluminium hydrate, potassium hydrate, or sodium silicate. The precipitation with lime water was not confirmed. Copper sulphate followed by potassium hydrate gave a gelatinous blue precipitate which contracted to a curdy mass upon boiling. Fehling's solution under similar conditions gave no coagulation—a point wherein the gum differs from many others, *e.g.*, yeast gums.†

A portion of the gum was boiled with 5 % sulphuric acid for five hours, when portions showed, upon being tested, the absence of gum and the presence of reducing sugars. After removal of the sulphuric acid by barium hydrate, the osazones of the sugars were prepared. They were obtained fractionally by the repeated addition of phenylhydrazine acetate solution followed by heating on the water-bath. Three fractions were obtained. These were, in great part, freed from tarry bodies by moistening with alcohol and treatment with ether.

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* Journ. Pharm. xx., 719.

† Lafar, Technical Mycology, ii., 1, 178.

The three fractions were separated into a number of portions by means of (1) warm water, (2) solution in hot alcohol and cooling of the solution, and (3) evaporation of the alcohol. All the fractions contained galactosazone and a small quantity of a vitreous yellow impurity which melted at 150°. The latter had undoubtedly been present in the osazone of my earlier research. No osazone other than galactosazone was obtained.

Thus the carbohydrate of *Bact. sacchari* is a galactan. It had been shown to give the furfural reaction, and in confirmation of its nature it was found to yield mucic acid upon oxidation with dilute nitric acid.

Galactan was also produced by the bacterium in fluid saccharose cultures, and especially was the presence of the slime shown when the medium contained chalk. In these solutions there was no production of reducing sugars, so that the organism did not secrete invertase. Acids were produced from saccharose, and the identification of these was necessary to complete the investigation. The medium in which they were formed consisted of saccharose 50 grm., peptone 5 grm., potassium phosphate 1 grm., potassium chloride 5 grm, chalk 10 grm., and water 1000 c.c. The method of separating the acids was essentially that described on pp. 118-120 of these Proceedings.

The ratio of the volatile to the non-volatile acids was as 8·1 : 34·7, or roughly as 1 : 4. The former consisted of acetic and formic acids. Acetic acid was identified by the silver salt and the odour. Formic acid was proved by the blackening of the filtrate from the silver acetate and the formation of calomel upon boiling the solution of the acids with mercuric chloride. The non-volatile acids consisted of succinic with small quantities of lauric and palmitic. The first was identified by its melting point, capability of being sublimed, and by the formation of the ferric salt. The separation of the lauric and palmitic acids, which separated as a fat after removal of the ether, was effected by warming the mixture upon porous porcelain at 45° for some hours. The residue on the porcelain melted at 61° (palmitic acid m.p 62°) and that absorbed by the porcelain and recovered from it melted at 44° (lauric acid m.p. 43°).

During the fermentation of saccharose, carbon dioxide was evolved. This was shown by drawing the air in small culture flasks through baryta water. The method of procedure has been described on page 548 of these Proceedings. Ethyl alcohol was also produced This was separated from the culture media in the manner described on page 344.

Summary.—In media containing saccharose, *Bact. sacchari* produces a galactan gum, carbon dioxide, ethyl alcohol, lauric, palmitic, succinic, acetic and formic acids.

ON A NEW SPECIES OF *CALLITRIS* FROM EASTERN AUSTRALIA.

By R. T. Baker, F.L.S., Curator, Technological Museum.

(Plate xlv.)

Callitris gracilis, sp.nov.

A tree attaining a height of over 20 feet, with a diameter from 1 to 2 feet, and having a hard, compact, bark similar to that of other species of Callitris. Branchlets numerous and slender, having a bright green colour; internodes terete or with very obtuse angles, the leaf-scales or teeth small and acute.

Male amenta terminal, seldom axillary, solitary or only occasionally two together, 3 lines long and slightly exceeding the branchlets in diameter, cylindrical, oblong. Stamens in whorls of 3, imbricate in six vertical rows; apex scale-like, ovate or orbicular, concave, with 2 anthers (2-celled) at the base. Female amenta about 1 line in diameter, having 6 scales, solitary or 2 or 3 together, fairly numerous below the terminal drooping branchlets.

Fruit-cones large, solitary, globular or compressed globular, from 1 inch to 1¼ in diameter or even larger; valves 6, very thick, smooth or slightly rugose, furrowed at the junctions, the three larger ones broadest at the middle and then tapering upwards and very thick from the base to the middle, the smaller ones about one-half as wide as the larger and shorter in length; the dorsal point minute and close to the apex. Seeds dark-coloured, the wings varying in size and shape.

Hab.—New South Wales: Tal Tal Mtn., and Gowie Range, Bylong, near Rylstone (J. Dawson, L.S.).

This pine tree was first brought under my notice in 1893 by Mr. J. Dawson, L.S., of Rylstone, who discovered it at the localities above given. As I had, prior to this, collected four other species of Callitris, *i.e.*, *C. calcarata*, R.Br., *C. glauca*, R.Br., *C. cupressiformis*, Vent., and *C. Muelleri*, Parlat., in this district, in fact, close to where this species occurs, it was easily seen that its characteristic branchlets and fruit differentiate it from any of these. In the fineness of the branchlets it approaches *C. glauca*, R.Br., and *C. robusta*, R.Br., but it lacks the glaucousness so characteristic of the former species, and the tuberculate, valvate cones of the latter, and is always found at higher elevations than these, as it occurs on ridges or rocky mountains in company with *C. calcarata*, R.Br., which species, however, extends on both sides of the Coast Range and well into the interior, whilst this species so far has only been found on the eastern slopes. The terete branchlets differentiate it from *C. calcarata*, R.Br., and *C. Muelleri*, Parlat.; and the fruits from *C. glauca*, R.Br., *C. robusta*, R.Br., and *C. cupressiformis*, Vent. The fruits show a remarkable likeness to those of *C. Muelleri*, but the branchlets of the two bear no resemblance, and this remark applies equally well to *C. calcarata*, R.Br.

Concerning the other species of Callitris enumerated in the 'Index Kewensis,' the differences are too obvious to be mentioned.

Summarising its specific affinities and differences, it has terete (but finer and without the glaucous) branchlets similar to those of *C. glauca*, R.Br., and *C. robusta*, R.Br., and fruits identical with those of *C. Muelleri*. The long, fine, drooping branchlets occasionally give it a willow-like appearance.

In botanical sequence it should come, perhaps, between *C. robusta*, R.Br., and *C. Muelleri*, Parlat.

This Callitris so far appears to be very local, for after a rather exhaustive botanical survey of the Pines of this State undertaken by me it was not found in any other locality, and there is no indication at present of any forms really transitional between it and any of the above-mentioned species, whilst it is distinct from any Western Australian Callitris.

EXPLANATION OF PLATE.

CALLITRIS GRACILIS, n.sp.

Fig. 1.—Twig with branchlets and male amenta.
Fig. 2.—Individual branchlets (enlarged).
Fig. 3.—Male amenta (enlarged).
Fig. 4.—Stamen with anthers (enlarged).
Fig. 5.—Cones unexpanded (natural size).
Fig. 6.—Cones expanded.
Fig. 7.—Seeds (natural size).

THE GEOLOGY OF THE GLASS HOUSE MOUNTAINS AND DISTRICT.

By H. I. Jensen.

(Plates xlvi.-l.)

Synopsis.

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i. Introduction.

The Glass House Mountains form a group of conical heights, scattered over a lenticular area whose centre is roughly forty-four miles north of Brisbane, S. Queensland. In this paper it is proposed to discuss, as well as the Glass House Mountains themselves, that portion of the East Moreton District in which they are situated. It comprises the parishes of Beerwah, Toorbul, Canning and Durundur, a few features of some other neighbouring parishes being also touched upon.

The Glass House Mountains were discovered and named by Captain Cook in May, 1770,* and again noticed by Flinders in July, 1802.† They owe their name to their resemblance to glass houses, when viewed from Moreton Bay on a fine day after a shower. No one has so far ever made a systematic geological examination of them, our knowledge up to the present being derived from scattered notes of various geologists who rapidly toured the district. In the present paper I propose to give the results of over three weeks' field work in the mountains themselves, supplemented by a considerable amount of petrological work on the specimens collected, carried out in the geological laboratory of the University of Sydney. Having been a resident of Caboolture, near the Glass House Mountains, for ten years, I have had the additional advantage of being thoroughly acquainted with the entire district.

ii. BIBLIOGRAPHY.

The first geological record of the Glass House Mountains is that of Mr. Stutchbury, who, in 1854, described them as consisting of masses of metamorphic sandstone, left standing after the unaltered sandstone had been removed by denudation.‡

In 1875, the Hon. A. C. Gregory referred to them as "*outbursts of porphyry.*"§

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* Hawkesworth, J., "Account of the Voyages," &c. Vol. iii., 1773 [Cook's First Voyage, 1768-71].

† "A Voyage to Terra Australis in H.M.S. The Investigator." Vol. ii., p. 6, 1814.

‡ Jack and Etheridge, Geology and Palæontology of Queensland, p. 73, and bibliography there given.

§ Report on the Geology of Part of the Districts of Wide Bay and Burnett. Brisbane; Govt. Printer, 1875.

In 1888, the Rev. J. E. Tenison Woods, F.L.S., read a paper before the Royal Society of New South Wales on the "Desert Sandstone." With this paper he published plates illustrating what he terms "Prismatic Basalt, Glass House Mountains," and in the text he states that the "Glass House Mountains appear to be of the same age as a basaltic flow at Lytton, a few miles inland from Cleveland." In the same paper the author refers to the conglomerates and sandstones in the Moreton District as "Desert Sandstone"; and he remarks "that only a few fragments of coniferous wood have been found imbedded in it, proving nothing as regards age."

In a descriptive account of the Glass House Mountains in the 'Queensland Railway and Tourists' Guide,' compiled under instructions from the Queenland Railway Commissioners, the author, Mr. A. Meston, refers to the geology of the mountains, and perpetuates the old notion that they are composed of sandstone, and rise out of the Cretaceous formation.

In Appendix ii. of Jack and Etheridge's 'Geology and Palæontology of Queensland,' we read:—"Recently Mr. Henry G. Stokes has presented to the Geological Survey a series of specimens gathered in the Mountains themselves (*i.e.*, *the Glass House Mountains**), from which it appears that the staple rock is trachyte."

Mr. Stokes has since read a paper in which he further points out the intrusive character of the trachytes.†

Mr. E. C. Andrews, B.A., in a paper, "Preliminary Note on the Geology of the Queensland Coast, &c.,"‡ speaks of the Glass House Mountains as "monadnock-like" heights, which rise from a coastal plain. Mr. Andrews also considers this coastal "*plain*" or "*flat*" to be due to the redistribution by tidal action of fluviatile material.

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* The italics are mine.

† Trans. Nat. Hist. Society of Queensland, Vol. i., 1892, 3-4.

‡ Proc. Linn. Soc. N.S. Wales, 1902.

iii. PHYSIOGRAPHY AND TOPOGRAPHY.

(*a*) *Undulating Sandy Country.*—The coastal tract from which the Glass House Mountains rise as isolated peaks, consists of gently undulating country, which appears a "*plain*" or "*flat*" when viewed from the sea. It is covered with a sandy soil sustaining a forest vegetation consisting of Eucalypts (white-gum, blue-gum, red-gum, stringy-bark, cabbage-trees, ironbark), Tea-trees, Banksia, Casuarina, Callistemon and Xanthorrhœa. The grasses are poor. In the sour-soiled, swampy flats the grass-tree (Xanthorrhœa) never produces a trunk as on the ridges. Near the trachytic peaks themselves the sandy soil gives place to a grey, ash-like soil, which is even more incapable of supporting healthy vegetation, inasmuch as it becomes sour in wet seasons from want of drainage, and cakes in dry weather.

This kind of country extends from Deception Bay on the east to the outcrop of the Palæozoic rocks on the west. The Palæozoic rocks are met with about seven miles west of Caboolture; here their junction line with the Mesozoic takes a north-westerly trend so that they are only reached in fifteen or sixteen miles going due west from the Glass House Mountains Station, which is fourteen miles north of Caboolture, and about forty-six miles north of Brisbane. The D'Aguilar Range, which forms the watershed between the coastal streams and the Stanley River (a tributary of the Brisbane River) basin, consists at Mt. Mee of Palæozoic rocks; but from the vicinity of Delaney's Creek northwards it becomes a mere sandstone ridge, whose constituent rocks are of Mesozoic age.

The Palæozoic rocks of Mt. Mee and neighbourhood consist of slates, schists, phyllites, granites and diorites with veins of quartz intersecting the sedimentary rocks, and dykes of gneiss, syenite, hornblende rock and gabbro intersecting the granites. Many of the quartz veins and leaders, and several of the dykes are metalliferous.

The sandy soil of the coastal tract overlies and is probably derived from the subaerial denudation of a formation consisting of interbedded sandstones, shales and conglomerates, which is apparently continuous and identical with the Ipswich and Burrum Coal Measures. This formation is devoid of fossils excepting the very abundant silicified wood and a few ill-preserved leaves. In this paper it will be termed the Coal Measure Formation, identical with the Trias-Jura of Jack.

The above-mentioned Palæozoic rocks are put down by Jack as "Gympie Formation," but they may be much older. No fossils have as yet been found in them.

The rocks of the Coal Measure Formation are not horizontally bedded. On the contrary, they dip at varying angles, and form small anticlines and synclines. In places trachyte intrusions have served to bring about this result. The northern part of the D'Aguilar Range bears every appearance of being an anticlinal fold. This part of the range (lying north of Steep Hill) is between 500 and 800 feet in average height, and is composed of sandstones and conglomerates of the Coal Measure Formation, which do not present to the eye signs of great erosion, such as steep cliffs and escarpments, a feature so noticeable in the Hawkesbury formation of the Sydney basin. The strata dip (as far as my observations go) away from the summit of the range Towards Peachester, west of the range, sandy soil overlying sandstone occurs as on the east. The same formation continues northwards to the Blackall Ranges, where it has been fissured and partly covered by flows of basalt. The sandstones differ greatly in colour and texture, ranging from fine argillaceous sandstones to coarse conglomerates, and varying in colour from white to red. Some varieties are highly ferruginous, becoming a "sand-ironstone." Interbedded with them I have found white clay shales, as at Mewett's Mountain, near the Six-Mile Creek, and also near Mt. Tunbubudla, black carbonaceous shale in the bed of the Six-Mile Creek, about a quarter of a mile east of the railway line, and coarse conglomerates near Mt. Beerwah. Coal is said to occur to the north west of Mt. Mellum; and also in several places in the Stanley River basin, south of the Blackall Range.

In the sandy country, swampy tracts are abundant. East of the D'Aguilar Range they seem to mark the position of old water-courses. The Lagoon Creek marks the position of an old water-course, the greater part of whose drainage area has now been captured by the Caboolture River. The swamps contain deep black, peaty soil, consisting of matted vegetable matter, logs, &c., beneath which there is a floor of sandstone, sand and gravel, or clay. The lagoons or ponds in the swamps quite commonly have sandstone floors and walls, this sandstone containing petrified wood similar to and as abundant as that obtained in the rocks of the D'Aguilar Range.

Along the Deception Bay Coast we meet with numerous shell banks, containing oyster shells, Pecten, Cerithium, *Arca antiquata* and other shells, some of these banks being over a mile from the shore. These may indicate that some elevation has taken place, but it is perhaps more likely that they mark the old shore-line, land-resumption slowly taking place through tidal action. However there are grounds for believing that some elevation has taken place in recent times, some of the hills fronting the N.W. corner of Deception Bay having the appearance of true raised beaches. The sand banks more than two miles from the shore-line are certainly of wind-blown origin, containing no marine remains. These banks are, in my opinion, not river drift, the sand grains being too fine and even-sized to have a fluviatile origin.

Land-resumption by the action of the sea and organised life combined is at present going on in Moreton Bay; the coastal alluvium may, therefore, consist of old shore-banks rendered terra firma by the gradual recession of the sea, and many of the salt marshes along the coast may represent little inlets and mouths of creeks, resumed in this way. (See Part vi., Notes by H. L. Kesteven).

(*b*) *The Glass House Mountains.*—These mountains are situated on an elliptical area, having its long axis north and south. The centre of the area is about 44 miles N. of Brisbane. They all rise very sharply out of the Coal Measure sandstone, their summits being either quite bare or only scantily decorated with a few dwarf gums, orchids and mosses. Mt. Beerwah, the loftiest cone of the group, is only 1,760 feet high; Mt. Conowrin 1,170 feet; Mt. Tunbubudla 1,020; all the others being below 1,000 feet. They are all of a steeply conical, sugarloaf form, composed of trachyte which is for the most part columnar. The most southerly member of the trachyte cones that I have been able to find is the Round Mountain, a hill about three miles W. of Caboolture; the most northerly, Coochin Mountain, near Beerwah Railway Station.

Those mountains which rise directly from level country, *e.g.*, Tibrogargan, Tunbubudla, and Miketeebumulgrai, are surrounded by a gutter of boggy country, a few hundred yards wide, round which a sandy ridge, often with sandstone outcrops, is met with. This gutter, which is studded with "paddymelon" holes, may be due to a slight subsidence caused by the weight of the mountain, perhaps accompanied by faulting (a cauldron fracture), or it may be due to the wash of water down the steep sides of the mountain in rainy seasons.

(*c*) *Miscellaneous Notes on Physiography.*—A noticeable feature in the East Moreton district is the close correspondence between vegetation and geological formation.*

On the sandstone formation, oaks (Casuarina) are very plentifully distributed amongst the gums, and the grass-trees have trunks.

Where the soil is clayey, overlying shale, wattles are interspersed amongst tall straight gums and stringybarks.

On the ashy, caking soil from decomposing trachyte, vegetation is very scanty, consisting of crippled tea-trees and stemless grass-trees *(Xanthorrhœa)*. On the trachyte formation oaks are typically absent, but often a trachyte dyke is marked by a row of tall gums and oaks, which have here sufficient food as well as good drainage.

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* *Cf.* Mr. Maiden's Presidential Address to the Linnean Society of New South Wales, Proc. 1902, p. 682.

The basalt country (Mt. Mellum, Blackall Ranges, &c.) is invariably covered by dense scrub, containing numerous palms, tree-ferns, bamboos, canes, &c. The andesite tracts sustain chiefly large Eucalypts, which are remarkable for their crookedness on this formation.

In the slate country, both scrub and forest vegetation is present, the former along the valleys, the latter on the ridges. Moreton Bay figs, nettle-trees, canes and the so-called wild chestnuts are abundant, but few palms. Excellent timber, both pine and hardwood, is procured here. Cedar is more plentiful on basaltic soil.

Along the coast box-trees are abundant, and the shore banks usually sustain some Casuarina and bread-fruit trees, whilst growing in the water, mangrove thickets are of frequent occurrence.

In Mr. Andrews paper,* it is stated that:—"In the coastal regions one finds a few feet beneath the sand a sort of pipeclay, with ironstone nodules, extending to great depth." This statement is not strictly correct as far as my observations extend. Several wells have been examined to ascertain the succession of strata under the sandy soil. As a rule, after passing through the surface soil or sand, we reach a white or yellow clay, at a depth of two or three feet. This clay may have a thickness of from one to perhaps twenty feet; if thin, we usually find beneath it a layer of ironstone pebbles a few inches in thickness, and then sandstone, with or without the intermission of another clay band; if thick, there are several gravel and pebble bands in the clay, as was observed in a well on our own homestead, near Caboolture.

The pebbles of these bands are imbedded in a sandy clay, and have a rounded appearance as if water-worn. In places, particularly where intermingled with quartz gravel, they may be of fluviatile origin. On account of these pebbles a river drift theory of the origin of the East Moreton lowlands has been advanced. It has been suggested that the whole district has been in geologically recent times a vast estuary into which a river flowed, depositing the above-mentioned clays and gravels. On account of the great variation in the thickness of the clay and pebble layers indicating their purely local development in places where small streams have formerly existed, as well as for other reasons already recorded, I cannot entertain "the river drift" theory. My observations on the formation of ironstone pebbles furthermore lead to a different conclusion.

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* Proc. Linn. Soc. N.S. Wales, 1902, p. 149.

Rounded ferruginous pebbles were found in great abundance under that grey ashy soil formed from decomposed trachyte or trachyte tuff. On breaking them a core of trachyte was frequently found. In the vicinity of Mt. Conowrin, Mt. Beerburrum, and Mt. Miketeebumulgrai trachyte in course of weathering has been observed to disintegrate into rounded lumps covered with a ferruginous crust. This is particularly the case with trachytes rich in deep blue pleochroic amphiboles. It seems, therefore, that, in many cases, the pebbles can be traced to the decomposition of trachyte or trachyte tuff; it is very probable that in early Tertiary times a great portion of the district was covered with loosely cemented volcanic ashes and bombs. In localities where ferruginous pebbles are in course of formation, the decomposing trachyte has a nodular or tuberculate appearance. These pebbles are nearly all less than half an inch in diameter.

Another source of ironstone pebbles and nodules (from ½ to 3 inches in diameter) is the decomposition of the ferruginous sandstones of the Coal Measure Formation. In the sandstones, heavy ironstone concretions are abundant, and are left behind when the rock containing them has weathered away.

iv. GEOLOGY.

(1). *Structure and Origin of the Glass House Mountains.*— These mountains represent old volcanic plugs of trachytic lava which have forced their way into ancient tuff cones now denuded, or else have burst through fissures in the Coal Measure sandstone, reaching the surface in a very viscous state. In the latter case the viscous masses must have remained in the place where erupted, taking the form of mamelons.*

An inspection of the arrangement of the columns on Ngun Ngun and Tibrogargan clearly proves that the Glass House Mountains are not the remains of a huge lava sheet, as has been suggested by some. In most instances we see no evidence of the lava having flowed from the vent. At Mt. Ngun Ngun, however, very short lava flows have taken place.

The rock is typically trachyte. In some places it is so coarsely porphyritic as to become a felspar porphyry, as for example, the Mt. Beerburrum rock.

The felspar is universally of two generations, in phenocrysts often somewhat corroded, and in minute laths forming with ægerine the microcrystalline to cryptocrystalline base. Hence it is probable that the magma had already cooled and partly crystallised out at considerable depth, before it found vents and broke through to the surface.

The trachytic rocks are later than the sandstones (Ipswich-Burrum Coal Measures), as proved by the following facts:—

(1) The sandstones are traversed in various places by trachyte dykes.

(2) At the junction of the trachyte and sandstone the latter shows unmistakable signs of metamorphosis, such as hardening, induced crystallisation, and assumption of columnar structure.

(3) Small tongues of trachyte have been injected into the sandstones on the junction line.

(4) The sandstones have been disrupted and sometimes tilted at considerable angles by the trachyte. One good instance of this is afforded by an anticline caused by a trachyte dyke in a railway cutting about half a mile north of Beerburrum Station (Plate xlix., fig. 5). At Mt. Beerwah and Mt. Conowrin the sandstones dip away from the trachyte mass.

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* This is often the case with trachytic lavas. Compare the Puys of Auvergne, the phonolite hills of Bohemia, and the mamelons of the Isle of Bourbon. See "Volcanoes," by Judd, ch. v.

On the other hand, the trachytes are older than the other volcanic rocks of the district. There is evidence that basalt flows from Mt. Mellum have once extended to Coochin and covered trachytic rocks in that vicinity. The remarkable quartz-augite-hornblende andesite, which forms the surface rock at Grigor's place (Bankfoot House) contains abundant trachytic inclusions. Some of these inclusions, those obtained by me close to Bankfoot House, are analogous to the Beerwah trachyte; others, obtained at Mt. Bokay, close to Mt. Conowrin, consist of Conowrin trachyte.

The rock of the more rounded and less elevated members of the Glass House Mountain group is in general more basic than that of the steeper and higher mountains. The rock of Mt. Cooee, a hill lying a few hundred yards north of Mt. Tibrogargan, seems of very varying basicity, merging in places into a rock indistinguishable in hand specimens from the Bankfoot House andesite.

(2). *The order of eruption* seems to have been—

1. Tuffs like those of Trachyte Range.

2. Compact trachytes like those of Conowrin, Tibrogargan, Beerwah and Ewin.

3. More basic trachytes of Mt. Ngun-Ngun, Mt. Cooee, Mt. Beerburrum, Mewett's Mountain, and Medway's Mountain; trachytes containing much blue hornblende and ægerine.

4. Quartz andesites—the Bankfoot House formation.

5. Basalts, erupted at Mt. Mellum in the Blackall Ranges, and at Buderim Mountain.

(3). *Occurrence of Dykes.*—Dykes are abundant. On the main Gympie road, between Mt. Tunbubudla and Bankfoot House, one meets with a number of long narrow dykes running across the country in straight lines. They form a very noticeable feature, inasmuch as they can be seen at some distance and resemble artificial stone barricades when viewed from afar. The dykes met with on the main Gympie Road between Mt. Tunbubudla and Conowrin Creek all seem to radiate from the two Tunbubudla mountains (locally known as The Twins).

A very interesting dyke occurs on the western side of Mt. Conowrin, exposed by a landslip a few years ago.

The most conspicuous dyke in the district is, however, the one which has given rise to the anticline in the sandstones of a railway cutting half a mile north from Beerburrum Railway Station. This dyke has forced its way along a bed of shale interbedded with the sandstone, the lava having carried some of the shale before it in its path. The lava has seemingly come from the S.E., so that we get a mass of altered black shales, about 40 feet in thickness, exposed in section on the western flank of the cutting, whilst the original shale bed showing on the eastern flank has only a thickness of two or three feet at the most. On this side the trachyte dyke does not show. Evidently the lava has come diagonally upwards. (Plate xlix., fig. 5).

The finely crystalline nature of the dyke rocks, as well as their close resemblance structurally and mineralogically to the trachytes of adjacent peaks, seems to me to show that they are derived from the same source, and contemporaneous. From their texture it is evident that they consolidated near the surface, and hence it appears that the amount of denudation undergone by the Triassic rocks since the trachyte eruptions has been small.

(4). *Possible Laccolites.*—From Medway's Mountain on 58v Canning westward, an area including selections 2v, 58v and 86v has trachyte rock underlying the surface soil. The trachyte here is considerably more coarse-grained and more ferruginous than that which has found vent in Medway's Mt. On weathering, it turns brick-red. Along the right side of the Durundur road, which crosses selections 2v and 86v, a trachyte outcrop many chains in width and nearly a mile in length may be traced. It does not reach an elevation of more than 10 to 12 feet above the surrounding country. The rock weathers into huge boulders in much the same way as granite, and in mineral composition it is analogous to the trachyte of Mt. Beerburrum. Within a radius of half a mile from it the soil is very poor, ashlike and caking, typical of decomposing trachyte. This is probably a laccolitic mass which has consolidated under a bed of sandstone or loosely cemented tuff, the coarsely crystalline nature of the rock and the viscosity of trachytic magmas generally, supporting such a supposition. It could also be interpreted as a large dyke mass. It is probably not a flow from any of the adjacent trachyte mountains, the rock being macrocrystalline and porphyritic.

(5). *Occurrence of Tufaceous Rocks.*—The occurrence of undoubted tuffs is very rare. Tuffs *may* formerly have covered a large area and formed cones round the trachyte plugs, but must have been very loosely cemented. Hence it seems improbable that the Glass House Mountains were submarine volcanoes, submarine tuffs being usually fairly compact. The only undoubted tuffs observed were those of a ridge to the south of Mt. Tibrogargan which I have called the Trachyte Range.* At a spot on this ridge—Skeleton Cave, south of Mt. Ewin—where I discovered some aboriginal skeletons in a cave, pyroclastic rocks with large angular fragments occur. Some specimens obtained on Tibrogargan may be tufaceous, but have not yet been properly examined.

Trachyte Range is a low continuous ridge of trachyte (rising in some places to an altitude of 300-350 feet above the surrounding country). It runs from Mt. Beerburrum in the direction of Mt. Tibrogargan, taking, however, a westerly trend at a place to the S.S.E. of Mt. Ewin, and continuing almost to the Gympie road. The core of the ridge consists of compact trachytic lava similar to that of Mt. Ewin, and also very like that of Mt. Jellore, of which Mr. T. G. Taylor, of the Sydney University, has kindly shown me some sections. At various points, as at Skeleton Cave, tuffs occur, these forming a hard, greenish rock, emitting a ringing sound when struck. They have evidently been highly silicified. The entire ridge evidently marks an earth-fissure which has emitted lavas and tuffs. Probably siliceous hot springs have altered the tuffs here and rendered them capable of resisting denudation.

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* The names, Trachyte Range, Skeleton Cave, Mt. Bokay, and Mt. Cooee, made use of in this paper, refer to localities which frequently require mention, but which have not as yet local names, nor do they bear names on the official maps.

(6) *Occurrence and Structure of the Andesite Formation.*—This formation covers an area of about 500 acres lying S.E of Mt. Conowrin. The andesite assumes an irregular columnar structure in places, and has to some extent prismatised the underlying conglomerates. It is extremely variable in basicity, being in some places pale grey in colour, in others perfectly black; sometimes rather fine-textured, sometimes coarsely porphyritic. The amount of quartz varies considerably. Perhaps the name dacite will be found more appropriate than andesite. It is important that it contains trachyte inclusions, hence is later than the trachytes. The geburite-dacites of Mount Macedon, Vic., were found to be the earliest trachytic rocks erupted in that region, so the order of eruption is somewhat different in the Glass House Mountains and Mount Macedon.*

(7) *Occurrence of Columnar Structure.*—Mt. Conowrin displays columnar structure on a grand scale. The summit is inacessible, and consists of a mass of vertical trachyte columns. These are square in transverse section (Plate xlvi., fig. 2).

The Mountains Beerwah, Ngun Ngun, Tibrogargan, Cooee, Ewin and Tunbubudla all show a central plug of columnar trachyte similar to that of Conowrin. In the case of Ngun Ngun we find, in addition to a mass of squarish columns exposed on the S.E. side of the summit, that the main body of the mountain is composed of huge columns of coarse-grained trachyte, rather rich in iron-bearing constituents. These columns are polygonal in transverse section; they are vertical on the summit, but horizontal or inclined on the sides of the mountain. A study of the arrangement of the columns on Ngun Ngun somewhat strengthens the idea that some of these mountains are of the nature of mamelons.

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* Gregory, J. W. (and Grayson, H. J.), "The Geology of Mount Macedon, Victoria." Proc. Roy. Soc. Victoria. Vol. xiv. (New Series), p. 186, 1902.

Mt. Beerwah is also entirely columnar. On the N.W. side, near the summit, we see a mass of fine rectangular columns similar to those of Mt. Conowrin. Near the base, however, the columns are tabular, and do, as Mr. Stutchbury has already remarked, lean inwards.* The large tabular columns of Mt. Beerwah consist of a peculiar glistening and soft trachyte which superficially resembles sandstone, so much so that Mr. Stutchbury described them as metamorphic sandstone. They contain large phenocrysts of plagioclase up to ¼ inch in diameter. The sandstone outcropping in a gully east of Beerwah dips 25° in the direction of Conowrin.

(8) *Occurrence of Basalts in the District.*—Mt. Mellum is basaltic. Its height is over 1,200 feet, and from the 500 feet level to the summit we meet with basalt only. The mountain was scaled from the south-east along a ridge which consists of sandstone until a height of 500 feet is reached. The lower basalt (between 500 and 600 feet) is vesicular, as is also the basalt of the summit. Between the two masses of vesicular basalt we meet with, in the ascent, a thick mass of compact columnar basalt. At the junction with the sandstone we find the latter strongly metamorphosed—turned, in fact, into quartzite.

Basalt-flows from Mt. Mellum have once extended south beyond Coochin. They are now denuded except for isolated patches of basalt and scattered basaltic nodules, but they have impregnated the subjacent sandstones with iron, and turned the sandy soil bright red.

Mt. Mellum probably represents a basaltic extinct volcano. It seems to me unlikely that it represents a flow for the following reasons:—

1. In the ascent, horizontal columns only have been met with.
2. Its isolation and seeming freshness.

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* New South Wales Geological Survey. Fourteenth Trimonthly Report, dated Durandur, 1st August, 1854. Legislative Council Papers, N.S.W., 19th September, 1854.

Very little denudation has taken place since its period of activity, although the rock is very decomposable. Its distance from the nearest basaltic mountains of the Blackall Ranges is about five miles, and if it represents a remnant of a denuded flow from them, a mass of basalt over 800 feet in thickness has been removed in the valley between them. If that were the case, it is hardly imaginable that we should meet with such excellently preserved vesicular basalt on the very summit of Mt. Mellum.*

The balance of evidence, therefore, favours the supposition that it represents a volcano.

(9) *Situation of the Volcanic Mountains on Intersecting Groups of Cracks.*—By looking at the accompanying map (Plate xlvi.) it will be seen that the mountains of the Glass House group lie on intersecting cracks, having approximately the directions N. to S. and E. to W. The main fissure seems to be that on which Miketeebumulgrai, Tunbubudla, Conowrin and Mt. Mellum lie. Another line may be drawn in a nearly parallel direction through Beerburrum, Tibrogargan, Ngun Ngun, Coochin Hill and Mt. Mellum. At right angles to these two lines we find one passing through Beerwah, Conowrin and Ngun Ngun; a parallel fissure passes through Mt. Beerburrum and the two Tunbubudla mountains.

The dykes radiating from Tunbubudla may be looked upon as radial cracks caused by the lava outburst.

(10) *Age and Origin of the Glass House Mountains and adjacent Rocks.*—There is no evidence that the Glass House Mountains have been submarine in origin. There are no submarine tuffs; the holocrystalline nature of the trachytes, as well as the occurrence of large fragments without any definite orientation in the Trachyte Range tuffs, and the absence of definite arrangement of the crystals in these tuffs are evidence against submarine origin. In the trachytic lavas, too, we meet with but

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* "Mellum" seems to be an aboriginal word for volcano. The mountain may have been active in the human period. Otherwise, why should the natives have given it the present name? Rumblings are said to have been heard under it last year.

few instances of vesicular structure, such as we should expect from the presence of much water, and no glassy rock, which would result from rapid cooling.

It is, however, likely that the sea was not far off at the time of the Glass House Mountain eruptions.

From the coarse-grained nature of the Triassic sandstones of the East Moreton district in the Glass House Mountain region and the abundance of fossil wood contained, it appears that these rocks were deposited in a wide estuary. Sedimentation may have lasted well into Cretaceous times, but so far no Cretaceous rocks have been identified in this region, though further north we have the Maryborough Beds overlying the Trias. When sedimentation ceased, the strata were elevated through rise of isogeotherms; at a somewhat later period—probably the end of the Cretaceous—recooling and denudation had progressed far enough to allow cracking of the sedimentary strata. Through cracks thus formed the Glass House trachytes found an exit. Subsequent folding of the topmost beds probably gave rise to the D'Aguilar Range and the Blackall Ranges, and this folding was probably accompanied by the andesitic and basaltic outpourings of lava.

In age the trachytes are probably Pre-Miocene. No definite proof of age has been obtained, but the amount of denudation which they have suffered and the almost total removal of tuff-beds and crater rings, if these ever existed, hint at considerable antiquity. The same lack of good evidence of geological age seems to hold for most Australian trachytes, but the consensus of opinion amongst our geologists, based on the small amount of evidence available, assigns to them a Cretaceo-Eocene age. This also seems to hold best for the Glass House trachytes.

The basaltic rocks of Mt. Mellum bear considerable petrological resemblance to those of Tambourine Mountain, described by Mr. Rands, late Government Geologist of Queensland.*

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* Jack & Etheridge, 'Geology and Palæontology of Queensland.'

Mr. Rands considers the Tambourine basalt to be Miocene or Pliocene, hence contemporaneous with many other Australian basalts. The Mt. Mellum rock is, if anything, later. The comparative freshness of this readily decomposable rock, the abundance of vesicular basalt, which is ever so much more readily disintegrated than hard columnar basalt, are reasons which justify us in assigning a late Tertiary, Pliocene or Pleistocene, age to Mt. Mellum.

In his paper already cited,* Mr. Andrews looks upon the Glass House Mountains as monadnocks, or hypabyssal masses left by the denudation of a Tertiary (Miocene) plateau into which the lavas had been injected. I cannot at present embrace that view, inasmuch as the D'Aguilar Range appears from my observations to be a Tertiary fold range, and not a remnant of a now-denuded plateau. Besides, the petrographical nature of the Glass House Mountain lavas and the occurrence of some tuffs in the ridge which is here named Trachyte Range, indicate that the rock is volcanic and not hypabyssal.

The upper sandstones of the East Moreton may be in part of Lower Cretaceous age, the Trias merging, as the Ipswich beds do, into the Cretaceous. The absence of later beds in the district can be explained on two hypotheses—either it has been dry land ever since Upper Cretaceous times, or repeated fluctuations causing periodical submergence have taken place. The latter supposition seems more likely to be correct, accounting satisfactorily for the absence of cliffs, escarpments, and other signs of great erosion. It seems the most natural conclusion to come to, that *moderately* stable conditions have prevailed in the Glass House Mountains area ever since the trachyte eruptions, and that the district has preserved its character as a low-lying coastal plain, occasionally submerged, but each period of elevation sufficing to remove the deposits formed in the period of sedimentation.

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* "Preliminary Note on the Geology of the Queensland Coast."

Greater denudation of the Triassic has taken place in the Blackall Range area, where sedimentation had been greater, and subsequently re-elevation more considerable.

That the eastern coast of Australia is undergoing a wave-like movement tangential to shore-line is rendered probable by the evidence afforded by numerous submerged forests and raised beaches along our coasts. Folding from the N.W. in New South Wales and from the S.W. in Queensland would explain such a tangential movement, the focus from which folding proceeds underlying the New England Tableland and the McPherson Range.*

Tidal action extends in the meandering Caboolture River as far as Wararbah Creek, and larger streams like the Caboolture and Stanley rivers have undoubtedly captured the drainage areas of other streams which are now represented by creeks and swamps. This indicates long-continued stable conditions, or at any rate *extremely slow* change of level. Sandy bars occur at the mouths of all the creeks and rivers. Yet it would be extremely risky to draw inferences from these features, as, on account of the soft nature of the Triassic bedrocks, and the vehemence of Queensland floods, it does not take a river very long to carve a course for itself in this region, and those rules which hold for hard Palæozoic formations can in this case only be applied with extreme precaution.

V. PETROLOGY.

The subject of the petrography of the Glass House Mountains rocks, the writer proposes to discuss in greater detail in a future paper.

An idea has already been given of the sedimentary rocks of the district, which comprise :—

1. The Palæozoic slates and schists referred by Queensland geologists to the Gympie Formation.

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* *Cf.* Suess' Theory on "The Parallel Grouping of Mountains round Ancient Coasts" in 'Das Antlitz der Erde.'

2. The Triassic or Trias-Jura rocks, consisting of sandstones and conglomerates, with interbedded shales and mudstones.

The igneous rocks may be divided into Plutonic and Volcanic, the dyke rocks being best considered with one or other of these divisions.

(A) PLUTONIC.—To this division belong the granites, diorites, gabbros, gneisses and augen-gneisses of the coastal range. These ancient rocks form the core of the range, being flanked on the eastern side by the Palæozoic slates and schistose rocks. They are cut by dykes of aplite, ægerine syenite, hornblende rock, diabase, &c., as well as by quartz reefs and leaders, usually more or less metalliferous.

(B) VOLCANIC.—The volcanic rocks of the district fall petrologically under three heads—trachytes, andesites, and basalts.

(*i.*) *Trachytes.*—The Glass House Mountains proper are all composed of trachyte. To make clear the mineral constitution of the most typical rocks, it will be useful to consider first a few special cases.

Beerburrum Trachyte.—Hand specimens of this rock when freshly broken have a glistening white marble-like appearance. On decomposing the rock acquires a reddish, or dull brick-coloured tint. The glistening of fresh specimens is due to large crystals of sanidine, up to ½ an inch in diameter. The rock is seen to be coarsely porphyritic, and to consist almost entirely of felspar, ferromagnesian minerals being only revealed on examination with a pocket lens.

Microscopic examination showed that the base consisted of lath-shaped, felspar crystals, of the sanidine variety, and two varieties of hornblende; the one hornblende is deep brown to reddish-brown in colour, strongly pleochroic, and more plentiful than the other variety, which is a deep blue pleochroic hornblende, probably riebeckite. A colourless pyroxene, non-pleochroic and with strong birefringence, is also present in scattered irregular grains.

From faint traces of multiple twinning in the porphyritic felspar phenocrysts it was suspected that they were not true orthoclase. These crystals are twinned like sanidine on the Carlsbad plan, and have a refractive index of 1·525. Measurements of extinction angles and microchemical tests proved a fair amount of soda and a little lime to be present. Hence some, if not all, of these phenocrysts are composed of anorthoclase.

Hand specimens of Beerburrum rock resemble specimen No. 9256 (Trachyte from the Canoblas) in the Sydney Mining Museum.

Beerwah Trachyte.—The specimen sectioned was obtained on the N.E. flank of the mountain, and is typical of the bulk of the Mt. Beerwah rock. This trachyte separates on weathering into huge shingle-shaped slabs. It has a very glistening, silky lustre when freshly broken, apparently due to the habit of the constituent felspar. The rock is very soft and crumbling, and has a greenish-grey colour. It was taken by Mr. Stutchbury, in 1854, to be metamorphic sandstone, probably on account of its tendency to split into slabs and its comparative softness. With aid of a pocket lens the rock can be seen to be porphyritic, containing abundant tabular phenocrysts of a plagioclase felspar. A few hornblende phenocrysts are also present.

Examined under the microscope, flow-structure is very apparent, the arrangement being trachytic-pilotaxitic as in the typical trachytes of the Siebengebirge (Drachenfels type). Felspar is the predominant constituent, both as sanidine with characteristic cross cracking, and in form of a plagioclase felspar which seems to be oligoclase or andesine. The crystals are lath-shaped, with their long axes all in the same direction. The base is microcrystalline and displays the trachytic variety of pilotaxitic texture. No glass is present. The ferromagnesian minerals are a brown hornblende, often in well shaped, twinned crystals; a strongly pleochroic hornblende, having green, blue and slate-coloured pleochroism in different sections. This latter amphibole is probably arfvedsonite, and is frequently seen enveloping the brown hornblende which is barkevicite. Ægerine is scattered plentifully throughout the base in minute rods. The chief characteristics of this rock are: the typical trachyte lustre, trachytic texture, predominance of plagioclase felspar (probably andesine, with which it agrees best in optical properties), and the tendency of the rock as a whole to split in slabs.

A few deep red to brown, strongly pleochroic grains, answering to the description of cossyrite, were observed as a nucleus to a crystal aggregate of the green hornblende (arfvedsonite).

Conowrin Trachyte.—This is a white or greyish-white rock in which a pocket lens reveals scattered black specks. A few felspar phenocrysts are usually present. Some specimens show flow arrangement to the naked eye. This trachyte forms the fine rectangular columns of which Mt. Conowrin is entirely made up.

Microscopically examined the Mt. Conowrin rock is seen to consist almost entirely of sanidine. In fact the other constituents do not form 3% of the bulk of the rock. The texture is holocrystalline and orthophyric. The ferromagnesian minerals present include ægerine in minute green pleochroic rods; scattered crystals of a blue hornblende which in transverse section show strong pleochroism from deep green to deep blue; in longitudinal section some of the crystals appear perfectly opaque. This amphibole is probably allied to arfvedsonite or riebeckite. It is identical with the deep blue pleochroic hornblende in the trachytes of Mount Jellore, near Mittagong, recently investigated by Messrs. Mawson and Taylor. This hornblende was the first mineral to crystallise from the magma, occurring often as inclusions in the centre of a sanidine phenocryst. Its crystalline form is never preserved, corrosion and resorption having taken place. A colourless non-pleochroic pyroxene is present in a few very minute grains.

A section made of a specimen of trachyte from the dyke at the landslip on the W. side of Conowrin is somewhat different in mineral constitution. The amphibole with the strong absorption in one direction is absent, and its place is taken by very numerous minute, acicular crystals of an olive-green colour. They are pleochroic in brownish and green tints. A few good crystals of a greenish-brown hornblende (allied to barkevicite) are present.

This is sometimes twinned. A few grains of riebeckite were present.

The rock from Mt. Ewin is macroscopically like that of Conowrin, but microscopically it was observed that the ferriferous constituents had taken chiefly the form of ægerine. A few phenocrysts of a brownish hornblende were also present (barkevicite).

Mt. Ngun Ngun Trachyte.—The main mass of Mt. Ngun Ngun is built up of huge polygonal columns of porphyritic trachyte. Specimens from here are macroscopically very like specimen No. 11227 (Trachyte from the Canoblas, Orange) in the Mining Museum, Sydney. The rock is holocrystalline, consisting of sanidine phenocrysts which are sometimes corroded, and a microcrystalline orthophyric base. The base contains sanidine, scattered irregular granules of a colourless non-pleochroic pyroxene, and the green pleochroic hornblende often with a nucleus of brownish hornblende. Fragments of quartz are present as an accessory, and also a few fragments of an orange-yellow mineral. The quartz is probably allogenic, derived from the sandstone in the upward passage of the magma. Another variety of trachyte is found on the S.E. side of Ngun Ngun; this is exactly similar in structure to that of Mt. Conowrin. There is also a third variety found on the E. side of the mountain; this rock is of a bluish-grey colour, very hard, and emits a ringing sound when struck. In section it was found to be composed of sanidine in phenocrysts, lath-shaped sanidines, and deep blue hornblende and green ægerine in the base.

Round Mountain Trachyte.—Hand specimens of this rock are often much darker in colour than usual, so as to suggest a fine-grained andesite. But the darkness is entirely due to mineral solutions which have permeated the rock after its formation. Sections prove the Round Mountain rock to be a holocrystalline trachyte, very fine in texture, but containing a few small sanidine phenocrysts scattered in a microcrystalline to cryptocrystalline base. The rock consists almost entirely of sanidine felspar, ægerine in minute granules, and a few scattered crystals of the deep blue hornblende (riebeckite) which has also been noticed in some of the fine-grained Conowrin rock. The phenocrysts of sanidine are frequently strongly arched, having evidently been subjected to very great pressure in the upward passage of the magma. The sanidines are twinned on the Baveno, Carlsbad, and Manebach laws.

Some of the hand specimens of Round Mountain trachyte are not unlike specimen No. 10559 (from ¾ mile N. of Tondeburine Ck., Warrumbungle Mts.), Mining Museum, Sydney.

Mt. Cooee Trachyte.—The rock composing Mt. Cooee varies widely in macroscopic appearance. Some is dark-coloured, coarsely porphyritic, and resembles the andesitic rock of Grigor's Estate, into which it seems to merge. The specimen sectioned was of a bluish-grey colour; this rock forms irregular columns, and weathers into rounded boulders. It is comparatively rich in quartz, which occurs in large crystals easily seen with the naked eye. In colour and texture this rock resembles specimen No. 11215 from Orange, in the Sydney Mining Museum.

The constituents of the quartz trachyte are sanidine—the most abundant component—a considerable amount of quartz, and a small proportion of dark-blue hornblende. The central part of Mt. Cooee consists of square columns similar in colour, size and shape to those of Mt. Conowrin and Mt. Ewin. Whether the quartz-trachyte, quartz-andesite, and true trachyte of this mountain are contemporaneous or not, and whether they are derived from the same magma, I have not yet been able to determine; but the order of superposition in places where superposition could be ascertained, is—(1) trachyte, (2) quartz-trachyte, and (3) quartz-andesite.

Trachyte Range Rock.—This rock is a true pyroclastic rock or tuff. It is of a dark green colour, very hard, and emits a ringing sound when struck; it also contains angular opaque fragments of a dark colour. Under the microscope it is seen to consist of cryptocrystalline and amorphous material, forming a base containing scattered sanidine crystals and angular fragments. The substance of the base is in the form of minute needles and granules, and is chiefly felspar, a darker green mineral being also present in fine needles. This is probably acicular microlites of ægerine. Glassy material seems also to be present.

True trachyte lavas also occur on Trachyte Range, forming the summits of the ridge. They resemble the rock of Mt. Ewin. One specimen obtained on the southern side of the ridge is macroscopically very like specimen No. 5006 (Riebeckite Trachyte, Warrumbungle Mts.), in the Mining Museum, Sydney. Microscopically examined, it is seen to consist of a holocrystalline, even-textured sanidine ground-mass, containing peculiar dark blue to black, arborescent aggregates of ultra-microscopic crystals, probably a hornblende, arfvedsonite or riebeckite.

The trachytes of Mt. Miketeebumulgrai are partly fine in texture like that of Mt. Conowrin, and partly coarse and porphyritic like that of Mt. Beerburrum.

Mt. Tibrogargan is composed of trachytes of a fine texture, resembling those of Mt. Conowrin and Mt. Ewin. They seem to be essentially ægerine trachytes.

To sum up and generalise, it might be said that most of the Glass House Mountains are composed of columnar trachyte. The core of the mountain usually consists of vertical columns, and the sides often of horizontal and slanting columns (*e.g.*, Ngun Ngun and Tibrogargan). The trachyte rocks are usually of a grey colour and dull lustre. The more porphyritic trachytes (*e.g.*, Beerwah, Beerburrum, Ngun Ngun) contain more brown and greenish blue hornblende (barkevicite and arfvedsonite) than the more even-textured rocks. The hornblendes seem to have been the first mineral to crystallise, being usually very corroded, and often occurring as inclusions in sanidine phenocrysts. The sanidine phenocrysts are often corroded and partially resorbed; they possess the characteristic cross cracks parallel to the (100) plane. In the instance of the Beerburrum rock, the phenocrysts proved to be anorthoclase, containing a considerable amount of soda and some lime. In the coarsely porphyritic rocks ægerine is less plentiful than hornblende. The amphibole sometimes occurs in twinned phenocrysts.

The more fine-textured trachytes, such as those of the Round Mountain, Mt. Conowrin, Mt. Ewin, and Mt. Tibrogargan contain a greater proportion of ægerine and less hornblende. Occasionally crystals of deep blue, highly pleochroic riebeckite are present. The main constituent of all the trachytes, both coarse and fine, is felspar, anorthoclase, with sanidine (orthoclase) in the Beerburrum rock, andesine or oligoclase and sanidine in the Beerwah rock (the plagioclase being here the more abundant constituent), and sanidine, with or without some anorthoclase, in the other rocks; the more basic minerals form but a minute portion of the bulk of the rock. The hornblendes seem all to be soda-bearing varieties, strongly pleochroic and deep blue, green or greenish-brown, possessing strong absorption in certain directions, being allied to the species riebeckite, arfvedsonite, barkevicite, and cossyrite (?). The augite is chiefly a soda-bearing variety, ægerine, in rods and needles.

Pilotaxitic and *trachytic* textures are seen in the rocks of Mt. Beerwah, Round Mountain and in some of the Conowrin rock. A *microrthophyric* base obtains in most of the other trachytes.

Holocrystallinity is univeral in the trachytes, but the grain size of the base varies from cryptocrystalline to microcrystalline. Porphyritic structure is also prevalent.

The felspar phenocrysts are usually somewhat corroded, though sometimes perfectly idiomorphic; hence the felspar seems to be of *two generations*, partial crystallisation having taken place in a subterranean reservoir, leading to the formation of the blue hornblendes with strong absorption, the deep green hornblendes (arfvedsonite), and many of the felspar phenocrysts. Partial resorption has taken place in the upward passage of the magma.

Zoning is common in the idiomorphic felspar phenocrysts.

(*ii.*) *Andesite (Dacite) Formation at Grigor's Place.*—This lava varies immensely in composition, texture, colour, &c. It covers an area of about one square mile, lying between Beerwah, Conowrin, Tibrogargan and Ewin. The colour of the rock is for the most part dark grey to black, but in the close vicinity of Bankfoot House we find it—

(1) Green, hard, compact without fragments.
(2) Red, soft, not unlike a tuff (weathered sp.).
(3) Dark brown, basaltic-looking.
(4) Grey, with huge black fragments, and quartz phenocrysts.
(5) Nearly black, with fragments and quartz phenocrysts.

These different kinds of rock all form part of one flow, and merge into one another. Some specimens are quite rhyolitic in appearance, some trachytic, some dacitic, and some very basic. In some places the lava has developed a pseudo-columnar structure, and has rendered the underlying sandstones columnar. Slides examined show the following constituents to be present in the blackish and commonest type of rock composing this flow :—

(*a*) Felspar. Plagioclase showing fine optical zoning and shadowy extinction, twinned on the Carlsbad, Albite and Pericline laws, is plentiful. The more basic interior is probably labradorite, and the less basic exterior andesine. Some orthoclase is present, also showing zoning (perhaps anorthoclase).

(*b*) Quartz is present in corroded crystals, with glassy inclusions. In some specimens it is very abundant.

(*c*) A variety of light green, faintly pleochroic augite in large crystals; extinction angle 34° to 56°.

(*d*) Hornblende of two varieties, one of a brown colour with characteristic cleavage, and one green fibrous variety.

(*e*) Magnetite is present as an accessory, and also a large amount of glass with inclusions and incipient crystals showing a fluidal arrangement.

(*f*) Green chloritic decomposition products are also present.

(*g*) Inclusions of trachyte are present. Some specimens sectioned contain inclusions of a plagioclase trachyte like that of Beerwah, with well marked pilotaxitic texture; one specimen obtained at Mt. Bokay contained an inclusion of Conowrin trachyte. These inclusions are important as affording evidence on the order of eruption of the lavas.

(*h*) Black, opaque, angular fragments are also present as inclusions.

Another specimen of the andesite formation, macroscopically of green colour and moderately fine texture, consisted of a pale hornblende (like edenite), a greenish glass, some magnetite, quartz, orthoclase, plagioclase and a little biotite. The pale green hornblende was the chief constituent.

(*iii.*) *Mt. Mellum Basalts.*—The basalts of Mt. Mellum bear close resemblance to the amygdaloidal basalts of Tambourine Mountain, described by Mr. Rands.

Mr. Rands describes the Tambourine basalts as amygdaloidal on the upper surface, generally full of olivine phenocrysts; and occasionally columnar, the columns being often 20 feet in length, and hexagonal in section.

The Mellum rock is in part vesicular, in part columnar. It contains large phenocrysts of olivine, plagioclase and black augite. The vesicular basalt occurs at the lowest and highest levels of the basalt. The rock is very *rich in olivine*; a dark red olivine (iron olivine, fayalite) is also present, and has taken the place of magnetite. *Fayalite* occurs sometimes as a nucleus to ordinary olivine, and was evidently the first mineral to crystallise. *Ilmenite* is present in tabular crystals, sometimes passing into leucoxene. The *augite* crystallised simultaneously with the *plagioclase*, the two minerals being intergrown. The augite seems to be titaniferous. The plagioclase agrees well in properties with andesine.

(c) OTHER ROCKS.—At the base of the Round Mountain, on the S.E. side, there is an outcrop of *aplite*, which probably marks the position of an outlier of palæozoic igneous rock. This aplite consists of quartz, orthoclase and plagioclase. Hand specimens are brick-red, and look like metamorphic sandstone. The mineral staining of the Round Mountain trachyte is probably connected in some way with this aplitic mass.

On the western side of the D'Aguilar Range at Butler's Creek, there are dykes of *ægerine syenite* traversing the granite. Recently, through the kindness of Professor David, I have had an opportunity of looking over a large number of specimens collected by Mr. J. M. Newman, B.E., at the Blacks' Reserve, near Woodford.

The country around Woodford is granitic. Mr. Newman obtained specimens of granite (both coarse and fine), gneiss, diorite, graphic granite, pegmatite (in veins), diorite, syenite and basic rocks. A dyke of basic rock like hypersthene anorthite gabbro, and a dyke of hornblende andesite composed almost wholly of hornblende, also occur here, intruding the granite.

vi. OTHER AUSTRALIAN TRACHYTES.

Professor Gregory has lately described an interesting series of Geburite-Dacites and Trachy-Phonolites occurring at Mount Macedon, Vic.* They seem to have many features in common with the rocks of the Glass House Mountains district.

The rocks of the Warrumbungle Mountains are recorded as trachytes by Professor T. W. E. David, who obtained there not only numerous specimens of trachytic lavas, but also tuffs interbedded with the trachytic magmas. In Wantialable Creek they overlie and are in part interbedded with diatomaceous earth and shales containing Cinnamomum leaves. The entire group of the Warrumbungle Mountains is known, through Professor David's researches, to form the wrecks of former trachyte volcanoes, and to consist of coarsely crystalline trachytic rock and interbedded tuffs.†

The trachytic heights of the Canobolas, near Orange, have lately received a great deal of attention and patient investigation by Messrs. Süssmilch and Curran, and it seems probable that these will prove to correspond in age and particulars to the other Australian Trachyte areas.

In Tasmania rocks analogous to our Australian trachytes have been discovered at Port Cygnet. They are chiefly Sölvsbergites, as are also some of the Mount Macedon rocks described by Prof. Gregory, of Melbourne. No definite flows have, so far, been found (*cf.* The Glass House Mountains, *ante*); in structure they are coarsely porphyritic, another point of resemblance to many of the Glass House Mountains lavas (*e g.*, Beerburrum, Ngun-Ngun). Fayalite-melilite basalt occurs not far away, at One-Tree Point, and has been described by Mr. Twelvetrees. Similarly in the Glass House Mountains area we have the Fayalite basalt of Mt. Mellum. The age of the Port Cygnet trachytes is Upper Cretaceous or early Eocene, approximately the same as that of the Mount Macedon rocks.

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* Proc. Roy. Soc. Vic. Vol. xiv. (New Series), pp. 193, 197.

† "Note on the Occurrence of Diatomaceous Earth at the Warrumbungle Monntains, N.S.W." Proc. Linn. Soc. N.S. Wales, 1896.

The trachytic lavas and the syenites of the Mittagong district have also during the last eighteen months received very thorough investigation at the hands of Messrs. Mawson and Taylor, of the Sydney University.* The Gib Rock syenite and neighbouring trachytes have been shown by them to be probably Upper Cretaceous, at all events Post-Triassic and Pre-Tertiary. In chemical composition they have found it to be exceedingly rich in alkali (Mawson).

At Port Mackay, in Queensland, trachytic tuffs are described by Mr. A. Gibb Maitland as abundantly interstratified with Desert Sandstone of Upper Cretaceous age.†

At Yeppon, near Rockhampton, Q., a range of trachytic mountains occurs.

A large number of steeply conical mountains are interspersed with more gently sloping (probably basaltic) mountains in low-lying country south of the railway line between Brisbane and Helidon (Main Southern Line). Many of these may yet prove to be syenitic or trachytic in nature.

Mr. Rands describes a mass of trachytes containing beautifully developed sanidine crystals as occurring in railway cuttings between Logan village and Beaudesert, near Walton Station. They seem to have come up through the Ipswich Coal Measures and to have flowed over a portion of them. A similar rock is described about one mile west of Walton village, apparently interbedded with the Ipswich Coal Measures. Mr. Rands is uncertain whether it is intrusive (laccolitic) or interbedded. The former supposition is probably correct.*

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* Paper read before Royal Society, New South Wales, October 7, 1903.

† "Geological Features and Mineral Resources of the Mackay District." By Authority: Brisbane, 1889. Also Jack & Etheridge, *op. cit.*, Text pp. 546-547, 1892.

All the Australian trachytes that have been chemically investigated are very rich in alkali, particularly soda. The Glass House Mountains trachyte probably will not prove an exception. Some specimens of Conowrin rock consist almost entirely of sanidine, but the Beerwah trachyte we find to be rich in plagioclase. The Mt. Mellum trachyte, like that of One-Tree Point, Tas., which is soda-bearing, contains an abundance of plagioclase and fayalite.

vii. Miscellaneous Notes.

The tendency of the Glass House Mountains to lie on linear fissures can be readily observed from one of the most southerly or northerly members of the group, *e.g.*, Round Mountain or Coochin Hill. Standing on the former height, one can get an excellent idea of the shape of the area on which the Glass House Mountains lie, as well as of their linear arrangement. From this point, fourteen or fifteen summits can easily be made out.

In connection with the question of cross-cracking, it is interesting to note that Mt. Mellum, Mt. Blanc and Candle Mountain, south of the Blackall Ranges, are three isolated peaks situated on a straight line running east to west parallel to the fissure on which Beerwah, Conowrin, and Ngun-Ngun are situated. Whether Mt. Blanc and Candle Mountains are basaltic or not, I have not been able to ascertain; but I am informed that the soil in the vicinity of them is very rich, hence it is safe to conclude that they are basaltic like Mount Mellum. The Blackall Ranges extend from Conondale east almost to the railway line, being approximately parallel to the two above-mentioned east and west fissures. Thence the range takes a northerly trend, becoming practically a continuation of the D'Aguilar Range, and running parallel to the main north and south fissure of the Glass House Mountains. Basalt-flows, producing fine rich soil, have taken place from many points along this range.

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* Jack & Etheridge, *op. cit.* p. 350.

The basaltic mountains of the East Moreton are easily distinguished from those composed of trachyte by the pretty gentle slopes, and rich tropical vegetation of the former. The Bankfoot House andesites seem to have been very fluid, much more so than the Mellum basalts. They have not given rise to any cones, but have flowed over sandstone formation and small trachyte outcrops alike.

In connection with the question of land-formation by the sea in Moreton Bay is the possible explanation of the shell-banks inland on the hypothesis that the sea has piled up bank after bank and thus retreated, Mr. H. L. Kesteven writes as follows:—

"During September, 1902, I had the opportunity of going through Bribie Passage and of examining in a cursory manner the country on either side of it. The 'Passage' runs between the mainland and Bribie Island. This island is wedge-shaped, about 17 miles long, and 3¾ miles broad at its broadest, southern, end; the greater part of it is but three or four, nowhere is it above 15 feet high. Its higher parts are blown (?) sand, and the lower black sandy mud. I was busy collecting mollusca, so did not have an opportunity of going over it thoroughly, but there is, I believe, no rock on the island anywhere. North of the high land at Toorbul Point, the mainland is of the same character.

"Some very interesting light was thrown on the growth of this low-lying country by Mr. C. Tripcony, in whose boat I went up the Passage.

"Owing to the strong current in the Passage, the bottom is continually shifting and changing the channel; the troubles of navigation were the subject of much conversation. Mr. Tripcony has owned oyster-beds in and sailed up and down the Passage for about twenty-five years. In the course of conversation, he pointed out to me an islet about two feet high at high tide, which he assured me did not exist in his early days on the Passage; on another occasion he drew my attention to some mangroves just showing above the water, and told me he had sailed over that spot, and that in a few years there would be dry land there.

"The mode of growth of this low-lying land, then, has been as follows:—

"(The shallows of the Passage are covered with lightly rooted marine grasses and weeds.)

"Back-waters or cross currents pile up a bank or shallow, the heavy mangrove seeds settle and take root. The mangrove once having taken root, not only puts its branches above the water but its roots above the soil. Anyone who has walked under a mangrove tree will remember that for yards round its trunk there are hundreds of spikes, a few inches long, sticking up from the soil in which it is growing.

"Here, then, we have a natural rake; the numbers of closely placed trees stop all that floats on the surface, while their roots stop heavier rubbish (loosened weeds) and sand moving along the bottom. Once our embryonic island reaches high-water level the rank grasses of the district take a hold and do their share of raising its height. Masses of matted grass roots, retaining soil, eighteen inches to two feet in thickness are frequently met with on the beach outside the northern end of Bribie Passage."

viii. CONCLUSION.

The present work was undertaken partly on account of the great lack of definite knowledge as to the geology of the Glass House Mountains, the views of different authorities varying within such wide limits; and partly to try to assist in the task of investigating and correlating the Australian trachytes. As shown in the part dealing with "Other Australian Trachytes," the work has been energetically tackled in Tasmania, Victoria and New South Wales by able investigators, whereas the Queensland trachyte areas have remained for the most part untouched, though of equally great importance and interest.

I am fully aware of the difficulty of the task I have undertaken. In a preliminary paper like the present it is impossible to deal with the subject so thoroughly as could be desired. Many problems remain untouched, and many of the interpretations given in the present paper may not be upheld by future investigators. I hope to continue the research by degrees, as opportunities arise, and other investigators may join. At all events it is hoped that this paper may prove a beginning in the thorough investigation of the geology of the Glass House Mountains.

I desire to express my thanks to the officers of the Geological Survey of Queensland for courtesy shown. I have particularly to thank Mr. L. C. Ball, B.E., for the photographs from which Plates xlvii.-l., accompanying this paper, were prepared, and for many other favours.

To Professor David and Mr. H. Stanley Jevons, of the Sydney University, I am indebted for the encouragement they have given in the present work, as well as for numerous useful hints, references, &c.

To Mr. Wm. Grigor, of Bankfoot House, Glass House Mountains, I am indebted for directions as regards roads and short cuts, and other useful information, as well as for many other acts of good will.

EXPLANATION OF PLATES.

Plate xlvi.

Map of the Glass House Mountains District.

Plate xlvii.

Fig. 1.—Portion of Mt. Conowrin, showing columnar structure.

Fig. 2.—Mt. Beerwah.

Plate xlviii.

Fig. 3.—Mt. Conowrin, showing the inaccessible portion of the mountain, consisting entirely of vertical trachyte columns.

Fig. 4.—Mt. Tibrogargan, as seen from a railway train.

Plate xlix.

Fig. 5.—Portion of railway cutting near Beerburrum Station, showing trachyte dyke causing an anticline.

Plate l.

Fig. 6.—Bird's-eye view of the Glass House Mountains from Mt. Ngun Ngun.

Fig. 7.—Bird's-eye view of the Glass House Mountains from Mt. Mellum.

(Figs. 1-7 are from photos by Mr. L. C. Ball, B.E., of the Geological Survey of Queensland, and are reproduced by permission).

THE EFFECT OF THE BASSIAN ISTHMUS UPON THE EXISTING MARINE FAUNA: A STUDY IN ANCIENT GEOGRAPHY.

By C. Hedley, F.L.S.

The marine mollusca of Western Port and Port Phillip in Victoria have been carefully examined by Messrs. G. B. Pritchard and J. H. Gatliff. The results of their work appear in an admirable Catalogue published in parts by the Royal Society of Victoria, and now approaching completion. If this fauna be compared with the marine mollusca of South Australia as reflected in the writings of the late Prof. Tate, it will be found to be in essential points the same. I have lately been favoured by my friend Mr. A. U. Henn with a small but important collection illustrative of the molluscan fauna of Geraldton in 29° S. lat. in West Australia.

Though here the Melbourne fauna commences to fade away and to be masked by the overlap of species characteristic of the tropical Indian Ocean, yet it is still recognisable. So the same fauna extends from Melbourne westward for 2250 miles to subtropical West Australia.

In the expectation of meeting at least some traces of the Melbourne fauna, I once devoted some days to collecting at Twofold Bay in southern New South Wales. Though at this point Melbourne is only distant about 450 miles along the coast, its fauna is quite absent. One misses, for instance, the large and handsome *Phasianella australis*, abundant on every beach along the whole south and south-west coast of this Continent. As the smallest fragment of this beautiful shell is readily recognisable, the absence of the species from the east coast of Australia is a matter of certainty.

Melbourne zoologists have frequently expressed to me their surprise at the difference between the fauna they find on the shores of Sydney Harbour and that they know at home.

It has occurred to me that the break in the marine molluscan fauna, which happens, as we know, somewhere between Twofold Bay and Western Port, or, as I suppose, at Wilson's Promontory, is associated with the vanished Bassian Isthmus.

Granted two propositions, to be considered later, viz., that the Bassian Isthmus existed, and that Tasmania then stretched further to the south; migration of marine forms from east to west, that is to say along isothermal zones, would be interrupted. To regain the accustomed temperature, an individual or species travelling east from the Great Australian Bight would require to double the south cape of Tasmania. At the present time this would mean the endurance of a low temperature. But at that time the prolongation of land to the south meant to the wanderer a still lower temperature. For we may fairly postulate that though the absolute positions of the zones of temperature might have varied in the past, yet the relative proportion of so many degrees of higher latitude to so many degrees of greater cold doubtless remained unchanged.

The check low temperature opposes to migration has been clearly expressed by Dr. W. H. Dall as follows:—"The temperature limits of many species are more sharply defined on the side of cold than on that of heat. The difference between 45° and 40° F. may absolutely check the distribution of a species which would find no inconvenience in a rise of temperature from 45° to 80°. It is probable that this is connected with the development of the young rather than the resisting powers of the adult mollusc."*

The union of Tasmania and Australia has been discussed by Mr. A. W. Howitt,† who points out that between Wilson's Promontory in Victoria and Cape Portland in Tasmania, by way of Flinders Island and the Kent Group, the greatest depth is 32 fathoms. A 35-fathom line on either side would indicate a plateau 80 or 90 miles wide about midway between the shores of the Strait, and on the Victorian side widening out so as to extend up to Cape Howe. The neck of the former isthmus, if the depths remain relatively unchanged, is between Wilson's Promontory and Kent's Group. An elevation of 300 feet would lay dry a tract of comparatively level country between Victoria and Tasmania rising to a central ridge on the eastern side.

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* Dall, Bull. Mus. Comp. Zool. Harv. Coll. xii., p. 180.

† Howitt, Rep. Austr. Ass. Adv. Sci. vii., 1898, pp. 723-758.

The proofs advanced by Mr. Howitt are so complete that no opposition is anticipated to the proposition that the Bassian Isthmus existed at a late geologic period. My second proposition that Tasmania at that date stretched farther south is perhaps more in need of support. If the depression of Bass Strait was associated with an undulatory south-north movement, then the Strait would be a trough, Tasmania a crest and the vanished southern tail of Tasmania would fall in a second greater trough. The dissected coast-line and the drowned river valleys of southern Tasmania indicate a recent subsidence.

Former writers on Antarctica, Dr. H. O. Forbes* for example, "restored" the Antarctic Continent by filling solid with land the southern quarter of the hemisphere. I have proposed† as a more probable condition, and one that would better suit the distribution of existing animals, that a comparatively narrow tract of land joined Tasmania with Antarctica. This suggestion has received the approval of Dr. A. E. Ortmann,‡ and for the purpose of the present inquiry may be admitted as a working hypothesis.

The arrangement of land and water sketched in the accompanying map and described above would be of later date, say Early Pliocene, than the Antarctic connection. If it at all approximates to the truth, the then condition of what is now the State of Victoria might be compared to the South American

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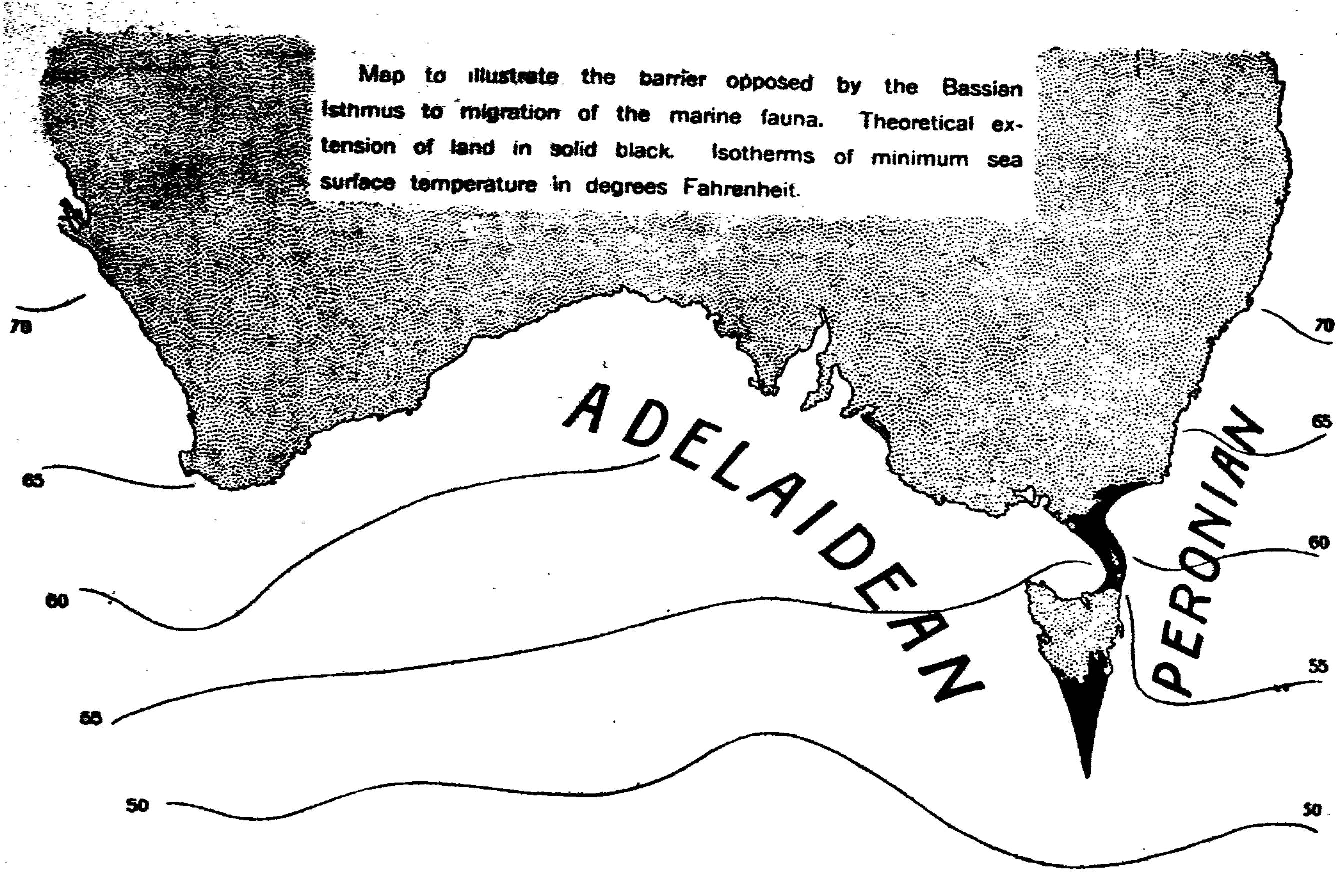
*Forbes, Supplementary Papers. Vol. iii. Royal Geographical Society, 1893.

† Hedley, Ann. Mag. Nat. Hist. (6) xvii., Feb. 1896, pp. 113-120.

‡ Ortmann, Rep. Princeton Univ. Exped. Patagonia, iv., Pt. 2, 1902, pp. 310-319.



Map to illustrate the barrier opposed by the Bassian Isthmus to migration of the marine fauna. Theoretical extension of land in solid black. Isotherms of minimum sea surface temperature in degrees Fahrenheit.

Republic Columbia. On the south, Victoria had access to a fauna of the Indian Ocean, as Columbia has access to an Atlantic fauna in the Gulf of Darien; on the south-east a fauna of the Tasman Sea inhabited the Gippsland coast, as a Pacific fauna in the Gulf of Panama occurs on the north-western shore of Columbia. The Isthmus of Panama answers to the Bassian Isthmus.

The marine fauna which extends from Melbourne along the south coast of Australia, and which was early elaborated in the neighbourhood of Adelaide by the researches first of G. F. Angas, and then of R. Tate, I now propose to distinguish as the ADELAIDEAN Fauna.* The marine fauna of the east coast of Tasmania, Gippsland, and New South Wales I propose to call the PERONIAN Fauna, in allusion to the famous French naturalist who sacrificed his life to his work on Australian zoology.

To these names I might take this opportunity of adding the DAMPIERIAN for the marine fauna which extends from Torres Straits to Houtman's Abrolhos; and the SOLANDERIAN for the marine fauna of the Queensland coast from Moreton Bay to Torres Strait.

Since the opening of Bass Strait considerable interchange has no doubt taken place between the Peronian and Adelaidean faunas. That no previous writer has observed its site as a faunal boundary, indicates how the line of demarcation has become obliterated. Possibly the prevalent westerly winds and consequent currents in Bass Straits have retarded the spread of Peronian forms, and accelerated the progress of the Adelaidean.

Antarctic forms advancing north would split on the Tasmanian wedge, and entering each region, supply an element common to both.

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* "The Adelaidean, including the coast and watersheds of the colony of South Australia," has already been proposed as a zoological subprovince of Australia by Tenison-Woods ("On the Natural History of New South Wales," Sydney, Government Printer, 1882, p. 49). His scheme is neither natural nor well-defined, and has been overlooked by Tate, Spencer and other writers on Australian zoogeography. The meaning I attach to "Adelaidean" is not that of Tenison-Woods.

It will probably be found that closely allied but distinct species, *Cryptoplax striatus* and *C. gunnii* for example, represent one another on either side of the site of the Bassian Isthmus.

West from Wilson's Promontory the coast-line included between the lines of 65° and 55° F. of minimum temperature is more than four times the extent of that between corresponding isotherms on the east. The endemic species of the Adelaidean region may therefore be expected to exceed those of the Peronian. So far as my studies have gone, this appears to be actually the case. I have been struck by the high proportion of endemic species among the Diotocardia. And I am inclined to believe that the range of species in space is usually more restricted in the Diotocardia than in the Monotocardia.

Our knowledge of the range of Australian marine mollusca is brief, being almost limited to the neighbourhood of the chief seaports. The compilation of lists of the fauna of intermediate localities is much needed. A comparison between the fauna of the east and west coasts of Tasmania should throw light on the questions here discussed.

In the following lists I have selected examples of species which appear to characterise the two faunas under review. When the attention of naturalists is drawn to this problem, I hope that fuller lists not only of mollusca but of other groups may be produced.

PERONIAN.

Haliotis cocoradiata, Reeve.
    brazieri, Angas.
Callomphala lucida, Ad. & Ang.
Liotia clathrata, Reeve.
Astele scitulum, A. Ad.
Calliostoma speciosum, A. Ad.
Monilea bellula, Angas.
    pulcherrima, Angas.
Cantharidus decoratus, Philippi.
Clanculus omalomphalus, A. Ad.

ADELAIDEAN.

Lucapinella pritchardi, Hedley.
Macroschisma producta, A. Ad.
    tasmaniæ, Sowerby.
Haliotis albicans, Quoy & Gaim.
    excavata, Lamarck.
    tricostalis, Lamarck.
    emmæ, Gray.
Liotia mayana, Tate.
    australis, Kiener.
Astele subcarinata, Swainson.

PERONIAN.

Clanculus floridus, Philippi.
clangulus, Wood.
Calcar tentoriforme, Jonas.
Turbo exquisitus, Angas.
Cæcum amputatum, Hedley.
Turritella gunni, Reeve.
sinuata, Reeve.
Zemira australis, Sowerby.
Potamides ebeninum, Brug.
Cassis nana, Ten. Woods.
Lotorium parkinsonianum, Perry.
Trophon speciosus, Angas.
laminatus, Petterd.
Typhis phillipensis, Watson.
Murex acanthopterus, Lamk.
Morula marginatra, Blainv.
Nassa peritrema, Ten. Woods.
Cominella filicea, Crosse & Fisch.
Siphonalia maxima, Tryon.
Voluta mamilla, Gray.
magnifica, Chemnitz.
marmorata, Swainson.
punctata, Swainson.
brazieri, Cox.
Microvoluta australis, Angas.
Drillia oweni, Gray.
Terebra venilia, Ten. Woods.
Dolabrifera brazieri, Sowerby.
Pugnus parvus, Hedley.
Ischnochiton australis, Sowerby.
Liolophura gaimardi, Blainv.
Cryptoplax striatus, Lamarck.
Acanthochites retrojectus, Pilsbry.

ADELAIDEAN.

Calliostoma legrandi, Ten. Woods
meyeri, Philippi.
Monilea preissiana, Philippi.
Cantharidus conicus, Gray.
irisodontes, Quoy & Gaim.
bellulus, Dunker.
lehmanni, Menke.
Clanculus yatesi, Crosse.
dunkeri, Koch.
maxillatus, Menke.
limbatus, Quoy & Gaim.
flagellatus, Philippi.
Phasianella australis, Gmelin.
Turbo gruneri, Philippi.
jourdani, Kiener.
Capulus australis, Lamarck.
Turritella australis, Lamarck.
Cypræa thersites, Gaskoin.
Cassis fimbriata, Quoy.
Lotorium verrucosum, Reeve.
Murex umbilicatus, Ten. Woods.
planiliratus, Reeve.
Sistrum adelaidensis, Cr. & Fisch.
Nassa fasciata, Quoy & Gaim.
Cominella costata, Quoy & Gaim.
alveolata, Kiener.
Trophon eburneus, Petterd.
Typhis yatesi, Crosse.
Josepha tasmanica, Ten. Woods.
Siphonalia tasmanica, Ad. & Ang.
Fusus lincolnensis, Crosse.
Voluta papillosa, Swainson.
fulgetrum, Sowerby.
Lyria mitræformis, Lamarck.

PERONIAN.

Glycymeris australis, Quoy & G.
Arca fasciata, Reeve.
Trigonia strangei, A. Ad.
Chlamys hedleyi, Dautzenberg.
Lima brunnea, Hedley.
Modiolaria varicosa, Gould.
Arcoperna recens, Tate.
Cuspidaria brazieri, Smith.
Cardita dilecta, Smith.
    cavatica, Hedley.
Lucina ramsayi, Smith.
    rugifera, Reeve.
Meretrix disrupta, Sowerby.
Chione calophylla, Philippi.
Solen sloani, Gray.
Mactra eximia, Deshayes.
Zenatia victoriæ, Prit. & Gatliff.

ADELAIDEAN.

Cancellaria purpuriformis, Val.
Triphora scitula, A. Adams.
Terebra ustulata, Deshayes.
    albida, Reeve.
Drillia quoyi, Desmoulins.
Operculatum corticale, Tate.
Ringicula australis, Hinds.
Ischnochiton juloides, Ad. & Ang.
    novæ-hollandiæ, Reeve.
Cryptoplax gunni, Reeve.
Acanthochites asbestoides, Carp.
Chlamys undulatus, Sowerby.
Pecten bifrons, Lamarck.
Limæa austrina, Tate.
Modiola victoriæ, Prit. & Gatliff.
Ectorisma granulata, Tate.
Cuspidaria tasmanica, Ten. Wds.
Crassatellites aurora, Ad. & Ang.
Cardita squamigera, Desh.
Lucina perobliqua, Tate.
Mylitta deshayesii, Recluz.
    gemmata, Tate.
Ephippodonta lunata, Tate.
    macdougalli, Tate.
Dosinia crocea, Deshayes.
Meretrix kingii, Gray.
Katelysia peronii, Lamarck.
Solen vaginoides, Lamarck.
Mactra abbreviata, Lamarck.
Anapella cuneata, Lamarck.
Gastrochæna tasmanica, Ten. W.

NOTES AND EXHIBITS.

Mr. Stead exhibited a specimen of the peculiar Copepod, *Sphyrion lævigatum*, Guér.-Mèn. (= *Lesteira Kroyeri*, G. M. Thomson in Trans. N.Z. Inst. xxii., p. 370, pl. 28, ff. 4, 4*a*, taken from a living *Genypterus blacodes*), which is parasitic upon fishes. It was collected by Captain W. Waller, from a fish caught in the Tasman Sea.

Mr. Baker exhibited (1) A specimen of the Conifer described in his paper. (2) Specimens of a truffle, *Mylitta lapidescens*, or "The little man's bread," obtained from the Droog Forest at an elevation of 5900 feet on the Nilgiris, where they are found on the ground at the base of large trees; they very much resemble in appearance and structure diminutive specimens of the Australian Blackfellow's Bread, *Polyporus mylittæ*, M. et C., specimens of which in fructification were exhibited at the meeting of the Society in October, 1902; so far, it appears that the fructification has not yet been found, so that there is a possibility of the species being referable to Polyporus and not Mylitta, in which genus the Australian Blackfellow's Bread was placed until its fructification was discovered. The specimens exhibited were received from Dr. R. L. Proudlock, of Ootacamund, India. (3) A very fine specimen of *Olearia dentata*, Andr., collected by Mrs. Helena Forde at Pambula; the usual diameter of the corolla of this species is ½-¾ inch, but in the specimen exhibited it measures just over 3 inches. And (4), specimens of a curious fungus, *Battarrea Tepperiana*, Ludw., from Nymagee, N.S.W.; collected by Mr. W. Bäuerlen, of the Technological Museum.

Mr. Cheel exhibited fresh specimens of Callistemon from three plants raised by Mr. F. C. Lovegrove, of Penshurst, from seed of the common Bottle-brush (*C. lanceolatus*, DC.). One plant produced flowers with rosy-pink filaments and yellow anthers; whilst the leaves are glandular-scabrous, agreeing with Bentham's description of *C. coccineus*, F.v.M. (Fl. Aust. iii., p. 120), as well as the figure in J. E. Brown's 'Forest Flora of South Australia.' There are specimens in the National Herbarium, Sydney, collected by Mr. E. Betche from near Como, in a natural state, which also agree with the specimens exhibited, as well as specimens labelled *C. coccineus*, F.v.M., collected by Mr. Gill at Port Lincoln, S.A., which are almost identical with the specimens exhibited.

Mr. Fred. Turner exhibited and offered some observations upon the following plants collected at Minembah, Upper Hunter:—(1) "Umbrella-" or "Spider"-grass, *Chloris acicularis*, Lindl., a plant he had not hitherto found growing on the eastern side of the Dividing Range, but which he had collected in many parts of the interior of Australia. It does not differ materially from the typical inland form, and, judging from the way stock eat it, it would appear to be equally valuable as a pasture grass in the Upper Hunter as in the far western country. It is figured and described in Turner's "Australian Grasses." (2) Diseased inflorescence of the introduced "Prairie Grass," *Ceratochloa unioloides*, DC., not hitherto observed in that condition by him. And (3) a white-flowering variety of the Australian "blue-bell," *Wahlenbergia gracilis*, DC., which was collected by Master Brown, who informed the exhibitor that he had seen only one other plant of its kind bearing white flowers in the district; the typical form of the Australian "blue-bell" is growing abundantly at Minembah.

Mr. H. G. Smith exhibited portion of a section of the trunk of *Orites excelsa*, R.Br., a Silky Oak, from Queensland, showing a cavity coated with a bulky deposit of aluminium succinate. The occurrence even of traces of aluminium is rare in Phanerogams; but in this remarkable plant that element seems to be necessary for the growth of the tree, as large quantities of alumina are yielded by the ash. Occasionally, as in the specimen exhibited, the amount taken up is abnormal, and then the excess is deposited in cavities as a basic aluminium succinate.

Mr. Jensen showed photographs, rock specimens, and rock sections under the microscope, in illustration of his paper.

WEDNESDAY, NOVEMBER 27TH, 1903.

The last Ordinary Monthly Meeting of the Society for the Session was held in the Linnean Hall, Ithaca Road, Elizabeth Bay, on Wednesday evening, November 25th, 1903.

Mr. Henry Deane, M.A., F.L.S., &c., Vice-President, in the Chair.

The Chairman made a preliminary announcement respecting the Macleay Fellowships Endowment—the late Sir William Macleay's last and crowning benefaction to Science. Subject to a life-interest in the principal on the part of his widow, lately deceased, Sir William bequeathed to the Society the sum of £35,000, for the foundation and endowment of Research Fellowships, tenable by graduates in Science of the University of Sydney upon certain conditions specified in the testamentary directions. On the 24th of last month the executors paid to the Society the sum of £33,250, which the Council had since invested at 4 per cent. per annum. As the rate was lower than that obtainable from similar investments at the time the will was made, and as the sum mentioned therein was subject to a 5 per cent. deduction for probate duty, the annual income available would certainly be less than Sir William contemplated; and consequently some slight modification of his plans would be necessary. Under the most favourable circumstances the Council could not expect to be in a position to make appointments before about the middle of next year. In the meantime the settlement of preliminary matters was receiving the Council's earnest consideration.

The Donations and Exchanges received since the previous Monthly Meeting, amounting to 12 Vols., 59 Parts or Nos., 37 Bulletins, 8 Reports, and 5 Pamphlets, received from 42 Societies, &c., and 3 Individuals, were laid upon the table.

THE VARIABILITY OF EUCALYPTUS UNDER CULTIVATION.

PART I.

BY J. H. MAIDEN.

In spite of the profusion of recent literature concerning the limitations of species in the genus Eucalyptus, an important aspect of the subject has been but little touched upon. I allude to the changes which the species undergo under cultivation. That variation does take place in cultivated species in Australia is well known; but it is in other parts of the world—in France and Algeria, in California and South Africa—that the changes have been most marked and noted. In fact it will be a surprise to many people how extensive is the list of new species of Eucalyptus described (chiefly in France) from plants raised from Australian seed.

This paper is of a preliminary character, mainly dealing with the extra-Australian species referred to. When in Paris a few years ago I was, through the kindness of MM. Edmond Bureau and Henri Hua, given an opportunity of studying the Eucalyptus herbarium in the Muséum d'Histoire Naturelle. Since my return to Australia these gentlemen have added to their kindness by sending to me nearly a thousand sheets of this genus, including a nearly complete set of the species of M. Naudin; I am thus enabled to speak with a confidence that I could not otherwise assume.

To M. Trabut, who has done excellent work with Eucalypts in Algeria, I am indebted for copies of his works and specimens of Eucalyptus hybrids.

To the Director of the U.S. National Herbarium, Washington, to Professor A. J. McClatchie, of Phœnix, Arizona, Mr. J. Burtt

Davy of Berkeley, and Mr. Abbot Kinney, of Los Angeles, California, I am indebted for specimens and literature concerning American grown Eucalypts; and to Mr. E. Hutchins, Conservator of Forests, Capetown, and others, I am indebted for South African specimens. To Dr. Prain, Superintendent of the Royal Botanic Garden, Calcutta, and Mr. I. H. Burkill, of the Calcutta Museum, I am indebted for much Indian grown material. Space will not permit detailed reference to the many other friends from whom I have received specimens of cultivated Eucalypts.

The botanist who, above all others, has given most attention to cultivated Eucalypts is the late M. Charles Naudin, Director of the Experimental Station at the Villa Thuret, Antibes, Southern France (Alpes Maritimes). He has published two masterly works on the subject* which for the sake of brevity I will henceforth refer to as 1st Mem., and 2nd Mem., respectively. Both works are rare, the latter excessively so. I have had the advantage of studying his specimens and of admiring the judicious remarks attached by him, not only to cultivated specimens but to the spontaneous Eucalyptus specimens in the Paris Museum.

M. Naudin desires to adopt the conservative attitude in protesting against the multiplication of species. Speaking of over 300 species being described at the date of 1st Mem., he adds, p. 338 :—

"Il est réellement beaucoup moindre, et l'exagération ici s'explique aisément par l'extrême variabilité des formes spécifiques; par les changements d'aspect, je dirais presque les métamorphoses que les individus eux-mêmes subissent en passant de l'état juvénile à l'état adulte; par la défectuosité des matériaux d'herbier, et aussi par la tendance ordinairement inconsciente de beaucoup de descripteurs à considérer comme espèces légitimes des formes qui, pour d'autres, sont de simples variétés."

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* (1) "Mémoire sur les Eucalyptus introduits dans la région Méditerranéenne." Annales des Sciences Naturelles. 6e. Série. Bot. T. xvi. pp. 337-430 (1883).

(2) "Déscription et emploi des Eucalyptus introduits en Europe, principalement en France et en Algérie." Second Mémoire. Antibes, 1891, pp. 1-72.

At the same time the following passage (p. 410) shows that he was inclined to split up species which Australian botanists with ampler material do not:—

"L' *E. Lehmanni* est certainement une des espèces les plus distinctes de tout le genre, et il serait difficile de le confondre avec aucun autre." He then goes into the question of the fusion of calyces which caused Schauer to form his genus *Symphyomyrtus.*

While it is evident from the notes I will give under each species that I am of opinion that most of M. Naudin's species cannot stand, yet I must point out that these Naudinian and other species-names must be respected in nomenclature, *e.g.*, *E. amplifolia* (unless superseded by a name of Robert Brown's) is a name that must be adopted if Naudin's contention that this particular form of *E. tereticornis* is worthy of specific rank is held to be valid.

Naudin had not completed his work of naming, for he ends his 2nd Memoir with the words, "Plusieurs autres espèces d'Eucalyptus existent dans nos jardins de Provence, mais leur étude n'est pas assez avancée pour me permettre d'en parler dans ce Mémoire."

It would add much to the value and interest of this paper if it could be illustrated, but as this is impossible, I will elsewhere publish figures of all species described from cultivated forms, later on. It will then be more fully understood that a study of cultivated forms is absolutely necessary for a proper realisation of the affinities of the species. Affinities between species are brought out by study of a long series of cultivated forms that might not be suspected if spontaneous specimens were alone examined.

It must be borne in mind that the naming of Eucalypts from cultivated specimens is not an invention of the moderns; the old botanists freely indulged in it, and their nomenclature, often an excrescence on botanical literature, as it has turned out, must be studied and taken for what it is worth.

I propose to arrange my paper in the following order:—

1. Species-names given to cultivated specimens by old authors.

2. Species-names given by Naudin and others to French and Algerian specimens.

3. Species-names given to American specimens.

4. Names given to cultivated reputed Eucalyptus hybrids.

1. SPECIES-NAMES GIVEN TO CULTIVATED SPECIMENS BY OLD AUTHORS.

1. *E. ambigua*, Dehnhardt (Cat. Pl. Hort. Camald. Ed. ii. 20) is *E. amygdalina*, Labill. var. *radiata*, Deane & Maiden.

2. *E. androsmæfolia*, Hoffmg. (Verz. Pfl. Nachtr. ii. 113) is *E. ovata*, DC. (Prod. iii. 218).

3. *E. calyculata*, Herb. Link. in Herb. Berol., is *E. amygdalina* var. *radiata*.

4. *E. camaldulensis*, Dehnh. (op. cit.) is *E. rostrata*, Schlecht.

5. *E. connata*, Dum-Cours, (Bot. Cult. Ed. ii., vii. 280) is *E. diversifolia*, Bonpl., DC. Prod. iii. 220.

6. *E. cordata*, Lodd. (Bot. Cab. t. 283) is *E. pulverulenta*, Sims.

7. *E. Cunninghamii*, Sweet, (Hort. Brit. Ed. ii. 209) is *E. stricta*, Sieb

8. *E. discolor*, Desf. (Tabl. Ed. ii. 198 nomen. Cat. Hort. Par. Ed. iii. 408) is *E. pilularis*, Sm.

9. *E. diversifolia*, Link, (Hort. Monac.) is *E. stricta*, Sieb. (probably).

10. *E. diversifolia*, Otto, is *E. amygdalina*, Labill. var. *radiata*, Deane & Maiden.

11. *E. elata*, Dehnh. (op. cit. 26) is *E. viminalis* according to Bentham; or *E. amygdalina* according to von Mueller; or *E. goniocalyx*, F.v.M., according to some sucker-foliage which I believe to be authentic.

12. *E. elata*, Giordano, is *E. amygdalina* var. *radiata*.

13. *E. elongata*, Link, (Enum. Hort. Berol. ii. 30; DC. Prod. iii. 222), "very doubtful" (Bentham) is probably *E. eximia*, Schauer.

14. *E. flexilis*, Regel, (Gartenfl. 1858, 284). I have been unable to see specimens.

15. *E. gigantea*, Dehnh. (op. cit. p. 20) is *E. globulus*, Labill.

16. *E. glandulosa*, Desf. (Cat. Hort. Par. Ed. iii. 408) is *E. amygdalina*, Labill.

17. *E. glaucophylla*, Hoffmgg. (Verz. Pfl. Nachtr. ii. 113).

18. *E. globularis*, Hort. (ex DC. Prod. iii. 219) is *E. amygdalina*, Labill.

19. *E. hypericifolia*, Dum-Cours. (Bot. Cult. Ed. ii. vii. 279).

20. *E. hypericifolia*, Link, (Bot. Cult. Ed. ii. vii. 279) is *E. cneorifolia*, DC. (? same as 19).

21. *E. Lindleyana*, DC. (Prod. iii. 219) is *E. amygdalina*, Labill.

22. *E. linearis*, Dehnh. (op. cit. p. 20), is probably a valid species.

23. *E. longifolia*, Lindl. (Bot. Reg. t. 947; Spreng. Cur. Post. 195) is *E. amygdalina*, Labill.

24. *E. media*, Link, "Jardin de Berlin, M. Otto, 1826" (DC. Prod. iii. 222).

25. *E. mucronata*, Link, (Enum. Hort. Berol. ii. 30) is *E. ovata*, DC. (Prod. iii. 218).

26. *E. myrtifolia*, Link, "Jardin de Berlin, M. Otto, 1826" (DC. Prod. iii. 222).

27. *E. oppositifolia*, Desf. (Tabl. Ed. i. 222) is *E. corymbosa*, Sm., according to a specimen, in leaf only, in Herb. Mus. Paris from the Jardin Noisette, 1812, presented by M. Bonpland in 1833.

A second specimen in the same herbarium, presented by M. Bonpland in 1833 and labelled in very old hand-writing "*opositifolius*" (sic) is indeterminable.

28. *E. oppositifolia*, Noisette. A specimen from Herb. Paris, is *E. tereticornis*, Sm.

29. *E. penicillata*, Hort. (DC. Prod. iii. 218) is *E. piperita*, Sm., or *E. eugenioides*, Sieb. (probably).

30. *E. perfoliata*, Noisette, is *E. pulvigera*, A. Cunn. (*E. cordata*, Labill.).

31. *E. perfoliata*, Desf. (Cat. Hort. Par. Ed. iii. 408) "very doubtful" (Bentham) is probably *E. globulus*, Labill.

32. *E. persicifolia*, Lodd. (Bot. Cab. t. 501) is *E. Gunnii*, Hook. var. *acervula*, Deane and Maiden (probably).

33. *E. populifolia*, Desf. (Cat. Hort. Par. Ed. iii. 408).

34. *E. procera*, Dehnh. (op. cit. p. 20) is *E. obliqua*, L' Hérit.

35. *E. pulchella*, Desf. (Cat. Hort. Par. Ed. iii. 408) is *E. linearis*, Dehnh.

36. *E. pulverulenta*, Link, (Enum. Hort. Berol. ii. 31 and Hort. Monac.) is *E. globulus*, Labill. (probably).

37. *E. purpurascens*, Link, (Enum. Hort. Berol. ii. 31) is *E. amygdalina*, Labill. I have also seen a splendid photo. of De Candolle's specimen. It is in leaf only, leaves strictly opposite. Evidently in the seedling stage. It is labelled "Jard. de Berlin, M. Otto, 1826," and "*E. purpurascens*, Link, *β. petiolulata*, DC." See DC. Prod. iii. 221.

38. *E. reticulata*, Link, (Enum. Hort. Berol. ii. 29; DC. Prod. iii. 222), "very doubtful" (Bentham). It was obtained from M. Otto, Jardin de Berlin, 1826. I have a remarkably good photograph of the specimen (in leaf only) examined by De Candolle for the Prodromus (iii. 222). It is very near *E. pallens*, DC., if not identical with it.

39. *E. rigida*, Hoffmgg. (Verz. Pfl. Nachtr. ii. 114; DC. Prod. iii. 221) is *E. obtusiflora*, DC.

40. *E. rubricaulis*, Desf. (Cat. Hort. Par. Ed. iii. 408). See *E. linearis*, Dehnh.

41. *E. stenophylla*, Link, (Jardin de Berlin, M. Otto, 1826; DC. Prod. iii. 222).

42. *E. tuberculata*, Parm. (DC. Prod. iii. 221), "very doubtful' (Bentham), "Jardin de Berlin, M. Otto, 1826." It is a narrow lanceolate specimen in the seedling stage; leaves strictly opposite. It is probably *E. amygdalina*, Labill., or *E. viminalis*, Labill.

2. SPECIES-NAMES GIVEN BY NAUDIN AND OTHERS TO FRENCH AND ALGERIAN SPECIMENS.

1. *E. amplifolia*, Naudin, 2nd Mem. p. 28.

Naudin says (loc. cit.), "il appartient à ce groupe embrouillé d'espèces et de variétés dont l'*E. tereticornis* peut être considéré comme le centre, mais il a en même temps des charactères si particuliers qu'on ne peut faire autrement que d'y voir une bonne espèce."

A specimen in fruit in Herb. Mus. Paris bears the following label in M. Naudin's handwriting:—

"*Eucalyptus amplifolia*, Ndn. Du bois de Boulogne d'Alger, administration forestière. Ch. Ndn."

A second specimen in young foliage bears the label:—

"*Eucalyptus amplifolia*, Naud. Cultivé à Cannes, M. Naudin."

A third specimen, evidently belonging to the second, bears the following label in M. Naudin's handwriting, together with a sketch:—

"*Eucalyptus amplifolia*, Ndn. Jardin du Riou, à Cannes, 14 Septembre, 1880, Ch. Ndn. Ombelles de 7 à 9 fleurs et quelquefois plus attenuées en un court pédicelle-pedoncle commun plus court que le pétiole. Arbrisseau, feuilles coriacés, très grandes. Opercule des boutons, conique ou cornu, plus long que le tube du calyce. Non *E. platyphylla*, Benth."

These specimens are identical with those of *E. tereticornis*, Sm. var. *latifolia*, Benth. (B.Fl. iii. 242; Deane and Maiden, Proc. Linn. Soc. N.S. Wales, 1899, p. 469; Maiden, Bull. Herb. Boissier, 1902, p. 571). Individual specimens are referred to in the last paper in the following words (p. 576):—"*f.* Goulburn to Bowral (J.H.M.). The 'Swamp Gum' form with long, narrow, horned opercula, broad leaves and small fruit. Received under the name 'Broad-leaf Blue Gum' from Marulan."

See also "*k.*"

See also "*y*" (p. 577). "New England, Glen Innes, Tenterfield, with broad sucker leaves and quadrangular stems, broad mature leaves and small fruits; also Tenterfield to Sandy Flat, very broad leaves and some with glaucous buds."

M. Naudin's specimens do not appear to have undergone any alteration in cultivation.

In the Catalogue of Vilmorin, Andrieux et Cie., Paris, it is described as "Grand arbre, remarquable par la rapidité de sa croissance. Acclimaté dans le Midi de la France et l'Algérie."

2. *E. Andreana*, Naudin, Rev. Hort. 1890, p. 346; 2nd Mem. p. 52. See also Kew Bulletin (Additional Series, 1900).

Named in honour of M. Edouard André, au Golfe Juan, who introduced it into France.

Copy of labels in M. Naudin's handwriting in Herb. Mus. Paris (Reçu en Mars 1890):—

"*Eucalyptus Andreana*, Ndn., Jardin de M. de Vilmorin, au Golfe Juan, Ch. Ndn."

It is *E. amygdalina*, Labill. var. *radiata*, Deane and Maiden (*E. radiata*, Sieb., non *E. radiata* in Hook. Fl. Tas.).

I have received similar specimens from MM. Vilmorin, Andrieux et Cie., of Paris, who describe it as "Arbre très elegant et très ornemental. Se couvre de fleurs blanches, du plus bel effet."

3. *E. angulosa*, Naudin (I cannot trace where this species was described).

Two specimens in Herb. Mus. Paris are labelled as follows in M. Naudin's handwriting:—

(1) In unripe fruit only. "*Eucalyptus angulosa*, Ndn. var du *tereticornis*? Villa Thuret, 12 Août 1887. Ch. Ndn."

(2) In leaf only. "*Eucalyptus angulosa*, Ndn., pourrait n'être qu'une variété à larges feuilles du *tereticornis*. Villa Thuret, à Antibes. Ch. Ndn."

The fruits are rather larger, and the pedicels shorter, than in *E. amplifolia*, Ndn., but it is undoubtedly, as Naudin suggests, a form of *tereticornis*, which is, as I have pointed out (Bull. Herb. Boiss. 1902), a very variable species.

In the Catalogue of MM. Vilmorin, Andrieux & Cie., it is stated, "Propre aux terrains secs arides."

4. *E. argentea,* (?) Cordier. Copy of label in Herb. Mus. Paris: "*Eucalyptus argentea.* Cultivé par Mons. Cordier, Maison Carrée près Alger, 1 Avril, 1876, Durandoz" (?).

M. Naudin has written on this label, "Je ne trouve aucun *E. argentea* décrit dans les auteurs." It is *E. melliodora,* A. Cunn.

5. *E. citryandra,* (?) Vilmorin, is *E. coccifera,* Hook.f. I have referred to this plant in Report Aust. Assoc. Adv. Science, Hobart Meeting, 1902, Vol. ix., p. 365.

6. *E. cœrulescens,* Naudin, 2nd Mem. p. 47. A label in Herb. Mus. Paris reads:—*Eucalyptus cœrulescens,* Naudin, du Bois du Boulogne d'Alger, Février 1883. Type. Ech. fructifère venant de la Villa Thuret (Alpes Mar.)." In flower and fruit.

A second label reads "*Eucalyptus cœrulescens* Ndn. Villa Thuret, Nov. 1889. Ch. Ndn." In bud only. They are referable to *E. melliodora,* A. Cunn.

I have received similar specimens from MM. Vilmorin, Andrieux & Cie. M. Naudin (2nd Mem.) recognised the affinity of this plant to *E. melliodora,* but he distinguishes *E. cœrulescens* by the shorter leaves, "and perhaps better by its general glaucescence." I may point out that *E. melliodora* is often glaucous.

7. *E. cultrifolia,* Naudin, 2nd Mem., p. 64. (I have seen this species referred to as *cultriformis,* Naudin). Copy of a label in Herb. Mus. Paris in Naudin's handwriting:—"*Eucalyptus cultrifolia,* Ndn. Jardin Nabonnand au Golfe Juan, Ch. Ndn." This is *E. eugenioides,* Sieb., a little altered under cultivation.

Another specimen in the same herbarium bearing the label "Eucalyptus not described which flowered in my garden last year, very few plants of it in this country, none of them flowered but with me" (in Lambert's handwriting), and the further label "Herb. Mus. Paris. Herbier donné par Mr. Bonpland en 1833. Cult. e horto Lamberto," to which is added, by M. Naudin, "paraît être l'*E. cultrifolia,* Ndn," is also *E. eugenioides,* Sieb.

"Espèce nouvelle, du moins très probablement" (Naudin).

It seems to me, from examination of a large number of cultivated specimens which I have referred to *E. eugenioides,* Sieb., and some of them nearly a century old, that this species is rather liable to alteration under cultivation.

8. *E. desertorum*, Naudin, 2nd Mem. p. 56.

Copy of a label in Herb. Mus. Paris, "*Eucalyptus desertorum*, Naudin (fragments de l'exemplaire typique). Originaire des déserts de l'Australie intérieure. Cult. à la Villa Thuret, Antibes (Alpes Maritimes). M. Naudin, 1889." It is *E. uncinata*, Turcz. A shrub, flowering abundantly the third year from seed.

9. *E. firma* (? auct. et ? cult.).

I have seen a specimen in Herb. Paris labelled *E. firma* which is referable to *E. diversifolia*, Bonpl.

10. *E. Foeld Bay*, ? Naudin.

"Belle espèce à rameaux retombants." (Cat. of Vilmorin, Andrieux & Cie.).

It is *rostrata*, Schlecht, or *tereticornis*, Sm., according to specimens from the above firm. I have seen only leaves and fruits. Buds are desirable, and also information as to where it was described.

11. *E. globulosus*, St. Lag., Ann. Soc. Bot. Lyon, vii. (1880), 125.

I have not seen specimens.

12. *E. glomerata*, Naudin. I do not know where it was described. I have seen only a head of fruits from which it appears, hardly with doubt, to be identical with *E. concolor*, Schauer.

13. *E. gracilipes*, Naudin, 2nd Mem. p. 37.

Naudin gives a general account of this supposed new species, which he says is "très analogue à l'*E. leucoxylon*." I have not seen a full suite of specimens, only fruits from MM. Vilmorin, Andrieux & Cie., and am not convinced that it is specifically distinct from *E. leucoxylon*, which is a somewhat variable species.

The Cat. of MM. Vilmorin, Andrieux & Cie., says :—"Espèce très voisine de l'*E. leucoxylon*. Elle en diffère surtout à l'état juvénile et à l'état adulte par son feuillage beaucoup plus clair."

14. *E. Huberiana*, Naudin, 2nd Mem. p. 42.

Described from one tree obtained at Nice, where it was cultivated by M. Huber, after whom it is named. This is another form, which, like *E. Mazeliana*, is allied to or identical with *E. viminalis*. It also has umbels with seven pedicellate flowers. Operculum conical, fruit truncate pyriform, and three-celled. I have not seen specimens. The part of Australia whence the seed was obtained is unknown.

15. *E. insignis*, Naudin, 2nd Mem. p. 30.

Naudin has described this supposed new species in a general way, but has not given a strict botanical definition. It is near *E. tereticornis*, but, in M. Naudin's opinion, distinct from it. I have not seen a specimen.

16. *E. jugalis*, Naudin, 2nd Mem. p. 37.

I have not seen specimens of this plant. "Quelques horticulteurs lui donnent le nom de *fissilis*. . . . Pour ne rien préjuger, je l'ai nomme *jugalis*, qui rappelle la disposition par paires des feuilles du premier âge" (Naudin, *loc. cit.*).

17. *E. Lamberti*, (?auct.).

This is *E. saligna*, Sm., according to specimens I have received through the courtesy of MM. Vilmorin, Andrieux & Cie.

18. *E. Mazeliana*, Naudin, 2nd Mem. p. 41.

Named in honour of M. Mazel, a cultivator of Eucalyptus in his garden at "Golfe Juan."

M. Naudin gives a general description of the plant. It has stood frosts of 12-13° C. "à Mont Sauve, dans le Gard," where it has been cultivated by M. Mazel.

It is described by M. Naudin as closest to *E. viminalis*. It is stated to have, in the young state, leaves narrower and longer than the generality of those of *E. viminalis*. The inflorescence and fruit, however, distinguish *E. Mazeliana* from *E. viminalis*. The umbels, axillary and pedunculate, are seven-flowered. I have not seen specimens. *E. Mazeliana* would appear to be near to (if not identical with) *E. viminalis*, Labill. var. *pedicellaris*, F.v.M (*E. Smithii*, R. T. Baker).

19. *E. Mülleri*, Naudin, Rev. Hort. 1st Sept., 1885, p. 406; 2nd Mem. p. 45.

A specimen in fruit and bud in Herb. Mus. Paris, bears the following label:—

Eucalyptus Mülleri, Naudin (ombelles normalement à 7 fleurs) ex exemplariis typicis. Villa Thuret (cultivé). Novembre 1889. M. Naudin."

A second specimen in bud and flower bears the following label:—"Env. par M. Ramel 1872. Cult. à Alger," to which M. Naudin has added "*Eucalyptus Mülleri*, ? Ndn." The specimen is more robust than the previous one, and they are both referable to *E. Gunnii*, Hook. f. var. *acervula*, Deane & Maiden.

Naudin (*loc. cit*) quotes this as an instance where it is not easy to indicate a species of Eucalyptus by a simple description. He says that at first *E. Mülleri* may be confused with *E. viminalis*, *goniocalyx*, and, above all, *Gunnii*. The normal number of flowers in the umbel is seven. It and *E. globulus* are the most rapid growers of all Eucalypts in France.

The Catalogue of Vilmorin, Andrieux & Cie., says:—"Remarquable par sa croissance rapide et sa rusticité relative. Il réussit bien dans les terrains rocheux et pierreux, même peu profonds. Haut 50m."

Even if my determination is incorrect, the name *Mülleri* cannot stand, as we already have *E. Muelleri*, Miq. (*incrassata*) 1856; *Muelleri*, T. B. Moore, 1886; *E. Mülleri*, Deane, Rec. Geol. Surv. Vict. Vol. i. 24 (1902); to say nothing of *E. Muelleriana*, Howitt (1890), and perhaps others.

20. *E. myrtiformis*, Naudin, 2nd Mem. p. 50.

Copy of a label in Herb. Mus. Paris:—"*Eucalyptus myrtiformis*, Naudin, Villa Thuret, Alpes Maritimes. Cult. M. Naudin. Reçu en Mars 1890."

This is probably *E. cneorifolia*, DC., but the anthers are not ripe. Are flowers and fruits available for examination?

M. Naudin knows only one plant, a shrub growing at the Villa Thuret. He points out that the buds remain two years before opening—a not uncommon thing with Eucalypts in Australia.

21. *E. pendulosa* (? auct.).

Maison Carrée près Alger, Villa Cordier 1877, 1er Avril, Durandoy (?).

A specimen in Herb. Mus. Paris is *E. viminalis*, Labill.

Naudin (1st Mem. p. 385) says:—"Il existe dans quelques jardins, sons le nom d'*E. pendula*, une variété du *viminalis* que ne me paraît différer par rien d'essentiel du type de l'espèce."

This must not be confused with the synonym of *E. bicolor*, A. Cunn. It may be identical with the *E. pendulosa* just referred to.

22. *E. pseudo-globulus*, (? auct.).

"Nous ne lui connaissons jusqu'ici qu'une seule variété, celle qui a reçu le nom de *pseudo-globulus*, qui ne se distingue du *globulus* ordinaire que par le volume de ses fruits, de trois ou quatre fois plus petits que ceux du type commun. Il y a d'ailleurs tous les passages entre les extrêmes de volume" (Naudin, 2nd Mem. p. 34). I know nothing more of this form.

23. *E. quadrialata* (? auct.).

"De collection, peu répandu" (Cat. of Vilmorin, Andrieux & Cie.). I have not seen the reputed species.

24. *E. rebrum* (?Cordier). Copy of labels in Herb. Mus. Paris:

(1) "*Eucalyptus rebrum*, Italia, Mai, 171, A. Cordier."

(2) "Doit être l'*E. crebra*. L'*E. rebrum* n'existe pas. 8e 74. Ramel."

(3) (In M. Naudin's handwriting) "Eucalyptus, n'est pas l'*E. crebra*." It is *E. Gunnii*, Hook. f. var. *acervula*, Deane and Maiden.

25. *E. scyphoidea*, Naudin. I do not know where it was described.

Copy of a label in Herb. Mus. Paris in M. Naudin's handwriting:—"*Eucalyptus scyphoidea*, Ndn. Species nova. Trouvé dans le jardin Nabonnand au Golfe Juan. Arbre unique dans le pays. Villa Thuret, 1889. Ch. Ndn."

This is *E. macrorrhyncha*, F.v.M. var. *brachycorys*, Benth.

26. *E. viminalis*, Labill. var. *fertilis* (? auct.).

"Splendide variété, relativement rustique, croissant vigoureusement" (Cat. of Vilmorin, Andrieux & Cie.).

I have not seen any specimens.

27. *E. vitellina*, Naudin, 2nd Mem. p. 65.

Copy of label in Herb. Mus. Paris in M. Naudin's handwriting: "*Eucalyptus vitellina*, Ndn., Jardin Narbonnand au Golfe Juan, 14 Janvier 1890. Ch. Ndn."

It is *E. amygdalina*, Labill. This was named from a young tree 8-9 mètres in height, and the only one known.

M. Naudin has pointed out the affinity of his species with *E. pauciflora* and *E. amygdalina*, and considers that it is intermediate between them.

I have some additional specimens of Eucalypts grown in French gardens which are labelled with recognised botanical names and which do not belong to the species indicated. By reason of paucity of material I am unable to speak more definitely.

3. SPECIES-NAMES GIVEN TO AMERICAN SPECIMENS.

1. *E. californica*, Kinney, "Eucalyptus,"* p. 191. On p. 177 he says, "What I have called *Eucalyptus californica* is by von Mueller called *occidentalis*." See *occidentalis* var. *californica*. There is a photographic figure of a twig of *E. californica* in Mr. Kinney's work.

2. *E. McClatchie*, Kinney, op. cit. 188. Species described from specimens in bud and flower, the only allusion to the fruit being "valves enclosed." "Bark sheds in long strips. The general appearance of the tree suggests *Eucalyptus globulus* or *goniocalyx*." I have not seen specimens.

3. *E. Mortoniana*, Kinney, op. cit. pp. 193 and 294 (with photograph of a twig). Specimens lent to me by the Secretary of the Smithsonian Institution (from the U.S. National Museum) appear to be referable to *E. Maideni*, F.v.M.

4. *E. occidentalis*, Endl. var. *californica*, Kinney, op. cit. p. 92. "*Eucalyptus obcordata* has the calyx sessile to the stalk, while

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* "Eucalyptus." By Abbott Kinney. Los Angeles, Cal., U.S.A.

our *Eucalyptus occidentalis*, which for convenience I shall name var. *californica*, varies from it in having long stalklets." The var. *californica* is still further described in several sentences. Vide *E. californica, supra*.

5. *E. pinnata* (?auct.). "The small grey-leaved *Eucalyptus pinnata* has grown well" (Kinney, op. cit. 117). I have never seen *E. pinnata* further referred to in print. Specimens of *E. pinnata* received from Mr. J. Burtt Davy, then of Berkeley, Cal., I referred to the Tasmanian *E. coccifera*, Hook.

4. NAMES GIVEN TO CULTIVATED REPUTED EUCALYPTUS HYBRIDS.

Dr. Trabut, of Algiers, has during the last few years named some Eucalypts which he frankly terms hybrids. Following is a list of those of which I have records. I may mention that it may cause inconvenience if hybrids be named just as species are, without any indication attached to the name that they are hybrids. In the case of M. Naudin's supposed species, the case is different, as he does not admit that they are hybrids; yet I think that the variation of some of them, at least, is caused by hybridism.

The question of hybridism in Eucalyptus is an important one, and considerations of space preclude discussion of it on the present occasion. I am of opinion that hybridism does play a part in the variation of species in the genus, and will take an early opportunity in another publication of expressing some of my views on the subject.

1. *E. Bourlieri*, Trabut, Rev. Hort. 1903, p 327; preliminary note in Rev. Hort. de l'Algérie, Aug., 1901, p. 239. Dr. Trabut in naming this plant after Dr. Bourlier, says (Rev. Hort. Alg.) "Enfin un hybride de *globulus* que je me propose de décrire et de dédier à l'arboriculteur distingué chez lequel il a pris naissance."

"Cet *Eucalyptus Bourlieri* est un bel arbre qui mérite une étude attentive. Dans bien des cas il n'est pas possible de déterminer exactement l'espèce qui a fourni le pollen, on est réduit à des conjectures.

"De ces observations poursuivies depuis une douzaine d'années, il résulte que certaines espèces du genre *Eucalyptus* cultivées dans la région méditerranéenne peuvent se croiser spontanément et donner naissance à des *types nouveaux*. Certaines de ces formes ont une descendance qui présente une fécondité et une fixité remarquables.

"Ces hybrides sont intéressants, car ils se montrent très robustes, très feuillus, il est probable que certains seront preférés aux espèces typiques introduites du pays d'origine."

E. Bourlieri is figured in Rev. Hort. The fruits (for samples of which I am indebted to Dr. Trabut) present a remarkable resemblance to those of *E. cordata*, Labill., but the leaves are quite different.

Dr. Trabut says (Rev. Hort. 1903), "L'*Eucalyptus Bourlieri* est evidemment un hybride de *globulus*, mais il ne parâit pas possible de déterminer le parent mâle; M. Bourlier inclinait pour le *robusta*, mais rien ne permet d'affirmer cette parenté."

2. *E. cornuta* × *Lehmanni*, Bourlier, in Trabut, Rev. Hort. de l'Algérie, Aug. 1901, p. 239.

A preliminary note.

3. *E. gomphocornuta*, Trabut, Rev. Hort. 1903, p. 326, with fig.

E. gompho × *cornuta*, "ayant analogie avec l'*E. occidentalis*" (Bourlier in Trabut, Rev. Hort. de l'Algérie, Aug. 1901, p. 239).

It has been referred to for some years as follows in the Cat. of MM. Vilmorin, Andrieux & Cie.:—"*Eucalyptus gompho-cornuta*, intéressant hybride d'*E. gomphocephala* et d'*E. cornuta*."

From Dr. Trabut's figure it so strongly resembles *E. gomphocephala*, DC., that it seems a pity to give it specific rank.

4 & 5. *E. gompho-occidentalis* and *E. Gunnii-globulus*, both distributed by MM. Vilmorin, Andrieux & Cie., are near *E. gomphocephala*, DC., as far as fruits are concerned, but I have not seen complete specimens.

6. *E. Rameliana*, Trabut, Ass. Fr. av. Sc. 1891 (reference not seen); Bulletin Agric. de l'Algérie et de la Tunisie, 15th July, 1901,* p. 326; Rev. Hort. de l'Algérie, Aug. 1901, p. 237; also Rev. Hort. 1903, p. 325, with figures of fruits and descriptions in both cases.

This is stated by Dr. Trabut to be a hybrid between *E. botryoides*, Sm., and *E. rostrata*, Schlecht.

The name is, however, preoccupied, there being an *E. Rameliana*, F.v.M. (Fragm. x. 84.)

7. *Eucalyptus Trabuti*, Vilmorin, Catal. gr. arbr. (name only). This is, according to Trabut, synonymous with *E. Rameliana*, which it should replace.

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* Before formally publishing it Dr. Trabut must have drawn attention to it some years previously, for in "The Eucalyptus in Algeria and Tunisia," by Edward Pepper, Proc. Amer. Philos. Soc. xxxv. (reprinted 29th May, 1896), I find, at p. 50, "*E. Rameliana* (hybrid from *E. rostrata* and *E. botryoides*, leafy and strong) obtained by Dr. Trabut."

NOTES FROM THE BOTANIC GARDENS, SYDNEY.

No. 9.

By J. H. Maiden and E. Betche.

RANUNCULACEÆ.

Ranunculus rivularis, Banks & Sol., var. inconspicuus, Benth.

Brown Mountain, near Lyttleton (E. Betche; January, 1893). The specimens agree exactly with Hooker's figure of *R. inconspicuus* in Fl. Tas. i. t.2b. It forms dense masses in swamps on the top of the Brown Mountain, between Lyttleton and Nimitybelle, N.S.W. Recorded previously only from Tasmania.

RUTACEÆ.

Zieria Smithii, Andr., var. tomentosa, n.var.

Mt. Useful, Vic. (A. H. S. Lucas; January, 1886): Mt. Tomah, N.S.W. (Jesse Gregson; December, 1897).

This variety is distinguished from the large-leaved normal form by the dense stellate tomentum of the underside of the leaves and young branches. From the tomentose *Z. furfuracea*, R.Br., it differs only in the absence of the tubercular glands and in the more close tomentum. Mueller united *Z. furfuracea* with *Smithii* as a variety; our new variety resembles *Z. Smithii* strikingly in every respect, except the indumentum, and we take this as a corroboration that Mueller's view of *Z. furfuracea* is correct.

We have previously published in these Proceedings (1901, p.79) a herbarium note from F. v. Mueller with the MS. name of *Z. Smithii* var. *Fraseri*. We find now that Mueller's var. *Fraseri* is so closely allied to *Z. cytisoides*, Sm., that, in our opinion, it should be included in that species.

BORONIA LEDIFOLIA, J. Gay.

Cowan Creek, Berowra (E. Cheel and J. L. Boorman; August, 1902).

A pinnate-leaved form with occasionally umbellate flowers. Though most flowers are solitary, some have two additional flowers in the axils of the small bracts on the peduncle, a variation not previously observed in this very variable species. Otherwise it is distinguished from the type by the very prominently ciliate filaments.

RHAMNACEÆ.

CRYPTANDRA AMARA, Sm., var. LONGIFLORA, F.v.M., ined.

Two well-marked varieties can be easily distinguished in our common *C. amara*, though, amongst a great number of specimens from different localities, they will be found running into each other. The small-flowered and more common form in the Port Jackson district has a calyx of about 1 line in length, with lobes rather shorter than the tube. The large-flowered variety has a calyx-tube nearly or fully twice as long, but with the same short calyx-lobes, so that the tube is proportionally much longer. Bentham took notice of these two forms in his 'Flora Australiensis,' but did not distinguish them by names. Baron von Mueller named the large-flowered form in the Melbourne Herbarium var. *longiflora*, and we propose his name for general adoption.

LEGUMINOSÆ.

SWAINSONA GREYANA, Lindl., var. BRACTEATA, n.var.

Between Gilgandra and Gummin (W. Forsyth; October, 1901).

This peculiar form of the Darling Pea is readily distinguished by the large, ovate, persistent bracts which completely conceal the young buds and nearly conceal the calyx in the opened flowers. The characteristic white tomentum of the calyx is much less dense than in the type, and the calyx-teeth are longer and more acuminate. Flowers and foliage precisely the same. Ripe fruits and seeds not seen.

GASTROLOBIUM BOORMANI, Maiden & Betche.

Milton (R. H. Cambage; December, 1902).

Previously recorded in these Proceedings from Tuggerah. The new locality brings its range more than 100 miles further south.

ACACIA PUMILA, Maiden & Baker.

Morriset (J. L. Boorman; October, 1899), Richmond (J. L. Boorman; May, 1903).

Since the publication of this species in 1895 (these Proceedings, xx., 385), many additional localities have been discovered, partly in the coast district from Port Hacking to Gosford, partly in the Blue Mountains as high up as Mt. Tomah; and the additional material necessitates some modification of the description. The phyllodia are described as 6 lines long and 1 line broad; it should read instead, phyllodia from ½ to nearly 1½ inches long, 1 line broad in the short-leaved forms, considerably narrower in the long-leaved specimens.

The two above-named localities are habitats of the long-leaved form.

ACACIA TRINEURA, F.v.M.

Temora (R. H. Cambage; October, 1900), Wyalong (J. L. Boorman; October, 1903). New for New South Wales.

UMBELLIFERÆ.

HYDROCOTYLE UMBELLATA, Linn., var. BONARIENSIS, Spreng.

Manly (first bay north of Manly, growing on the beach with *Carex pumila* and *Spinifex hirsutus;* A. A. Hamilton; November, 1902).

This interesting *Hydrocotyle* is common in North America, and seems to be of recent accidental introduction, though it is very difficult to account for it. It has peltate leaves, like the large-leaved forms of *H. vulgare;* but the umbels are on long stalks, and it is distinguished from all other species of this large genus by the irregular compound umbels.

We have to thank Dr. H. Harms, of Berlin, for the determination of this plant.

GOODENIACEÆ.

VELLEYA MONTANA, Hook. f.

Medlow, Blue Mountains (A. A. Hamilton; January, 1903).

A new locality for a plant rare in New South Wales. It is another instance of the occurrence of Tasmanian plants in bleak exposed situations of the Blue Mountains.

GOODENIA DIMORPHA, n.sp.

Springwood, Blue Mts. (E. Betche; February, 1884), Woodford, Blue Mts. (J. H. Maiden; January, 1899), Blackheath, Blue Mts. (A. A. Hamilton; January and April, 1900).

GOODENIA DIMORPHA, Maiden & Betche, var. ANGUSTIFOLIA.

National Park, near Sydney (J. H. Camfield, February, 1896; J. L. Boorman, January, 1903).

We have been puzzled for many years past by a Goodenia with a paniculate inflorescence, common in sandy turfy places from Port Hacking to the Blue Mountains. The species is so common that it can scarcely have been overlooked by old collectors, and still less by collectors of the present day; but its forms have probably been mixed up in various herbaria with several other species. The general appearance of the broad-leaved mountain form is that of *G. bellidifolia* with an unusually paniculate inflorescence; but *G. bellidifolia* has a short ovarium and fruit, and our new species has a long and narrow fruit. The narrow-leaved form may have been confounded partly with *G. stelligera*, or, in absence of fruit, with *G. paniculata* or *G. gracilis*, but differs from all in ovarium, fruit and inflorescence.

During recent years we made it our business to obtain fruiting specimens from all forms, with the result that we came to the conclusion that it belongs to Bentham's Section "Eugoodenia" series "Racemosæ," but that it cannot be united with either *G. bellidifolia* or *G. stelligera*. It is most nearly allied to *G. stelli-*

gera, with which it has the narrow capsule in common, and which shows also occasionally a tendency to a branched inflorescence, but from which it is always distinguished by the numerous slender panicle-branches, like G. paniculata and gracilis, and by the long stem-leaves.

We give the description of both forms separately :—

G. DIMORPHA (normal form)—Blue Mountains.

A perennial with a tufted stock and erect stems from 1 to rarely above 2 feet high, glabrous or nearly so, except the flowers. Leaves radical and rosulate, from oblong- to ovate-spathulate, from under 1 to 2 inches long, entire or obscurely dentate; stem-leaves few and small, becoming shorter and narrower towards the top, mostly supporting the branches. Stems few and slender, with slender distant simple branches, long at the base of the stem, shorter towards the top, each with a single terminal flower, or with a cluster of mostly three flowers on stalks of unequal length, or the panicle-branches are again divided. Flowers often (not always) with a pair of short and slender bracteoles at the base of the calyx (reduced stem-leaves). Calyx-lobes linear, about 1 line long. Corolla yellow, sparingly hairy outside, otherwise as in *G. stelligera* or rather smaller. Capsule linear-oblong, about 5 lines long, the dissepiment reaching nearly to the top. Seeds flat, with a small border, arranged in two rows in each cell.

GOODENIA DIMORPHA, var. ANGUSTIFOLIA—National Park.

A perennial with a tufted stock and erect stems about 1 to 1½ feet high. Leaves radical or scattered along the stems and branches, sometimes nearly all in a rosette and sometimes, chiefly on the stem, scarcely reduced in size. The two forms seem to depend entirely on the locality. Isolated growing specimens have mostly rosulate leaves and fewer stem-leaves, but if they grow together in dense masses, the radical leaves are few and the stem-leaves numerous. Leaves linear, about 1 to 1½ inches long, entire, or the radical ones more or less deeply toothed and linear-lanceolate.

Flowers and fruits as in the broad-leaved mountain form, but the slender stems are more numerous, and generally much more branched. The mountain form has occasionally woolly-hairy proliferous nodules in the axils of the lower branches; the same peculiarity is much more frequently to be found in var. *angustifolia;* in some specimens the nodules are in clusters close to the root, so that the numerous stems seem to rise from a densely woolly-hairy stock.

EPACRIDEÆ.

EPACRIS IMPRESSA, Labill.

Pigeon House Mountain, Milton (R. H. Cambage; January, 1903).

CONVOLVULACEÆ.

CRESSA CRETICA, Linn.

Wanganella, Hay District (Miss E. Officer; May, 1903).

A common plant in maritime and saline districts of the Old and New World. In Australia it is recorded from all States except Tasmania, and is common in South Australia, but in New South Wales it is restricted to the south-western corner.

Miss Officer writes:—"It covers large areas of open plain country in this district, especially land where water lies for a short time after rain. When in flower the whole air is scented by it."

MYOPORINEÆ.

MYOPORUM DESERTI, A. Cunn.

Scone, Hunter River (J. H. Maiden; May, 1902); Jenolan Caves (W. F. Blakely; June, 1899).

The two localities given are the most eastern localities of a species common on the western plains. The specimens from both localities are distinguished from the western specimens by the thin texture of the leaves, and consequently very prominent oil-glands.

CHENOPODIACEÆ.

BASSIA DIVARICATA, F.v.M.

Denman, Hunter River (J. H. Maiden and J. L. Boorman; May, 1902).

KOCHIA VILLOSA, Lindl.

Denman (J. H. Maiden and J. L. Boorman; May, 1902).

KOCHIA MICROPHYLLA, F.v.M.

Murrurundi (J. H. Maiden and J. L. Boorman; May, 1902).

Kochia microphylla was originally described by Moquin-Tandon as *Enchylæna microphylla*, and retained under that genus till Mueller removed it to *Kochia*. The Murrurundi specimens show beautifully the peculiarities of the species.

Most of the small fruits are quite wingless, which caused Moquin to describe it as *Enchylæna;* while now and then, on the same plant, a few fruits have the characteristic horizontal wing of the genus *Kochia* plainly developed.

AMARANTACEÆ.

PTILOTUS EXALTATUS, Nees.

Denman (J. H. Maiden and J. L. Boorman; May, 1902).

NYCTAGINEÆ.

BOERHAAVIA DIFFUSA, Linn.

Denman (J. H. Maiden and J. L. Boorman; May, 1902).

These five last enumerated plants (Chenopodiaceæ, Amarantaceæ, and Nyctagineæ) are common on the western plains, but entirely wanting in the coast district.

We have already, in a former paper in these Proceedings, drawn attention to the great number of western plants which make their way down the Hunter River valley, probably in times of floods, as far east as Denman and Scone; and the above are additions to the number already recorded.

PROTEACEÆ.

BANKSIA PALUDOSA, R.Br.

Near Eden (J. H. Maiden; October, 1901).

MONIMIACEÆ.

Daphnandra tenuipes, Perk., in Engler, Pflanzenreich, iv. 101, p. 75 (1901).

Tweed River District (E. Betche; March, 1894).

This new species is chiefly distinguished from *D. micrantha* by the broader leaves, more rounded at the base and hairy underneath, and by the looser and larger inflorescence.

The two species differ in fact in a number of, what might be termed by some, small particulars. In the aggregate there is no doubt the species are distinct.

In Miss Janet Perkins and Ernst Gilg's 'Monograph of Monimiaceæ' some very important changes have been made concerning New South Wales plants, which we bring here under general notice.

Wilkiea macrophylla, A. DC., Prodr. xvi. 2, p. 669 (1868). Syn. *Kibara macrophylla*, Benth., Fl. Austr. v. 288: *Mollinedia Huegeliana*, Benth., *op. cit.* v. 286; *M. macrophylla*, Tul., Mueller, Second Census.

Miss Perkins writes (Engler's Bot. Jahrbücher, xxv. 569):—"I cannot understand how Bentham could have placed this species under two different genera. I have seen the originals of *Hedycarya macrophylla*, A. Cunn. (synonymous with *Kibara macrophylla*, Benth.), and of *Mollinedia Huegeliana*, Tul., and have convinced myself that they belong with certainty to one and the same plant."

The mistake which both Bentham and Mueller made with regard to this plant seems to us to have been caused by the difficulty often experienced in matching male and female specimens in plants with unisexual flowers. However, in Bentham's description in the 'Flora Australiensis' the difference between the two plants is well defined by the number and disposition of the stamens. Bentham himself writes:—"The female and fruiting specimens (of *Mollinedia Huegeliana*) are, when glabrous, very difficult to distinguish from those of *Kibara macrophylla*."

WILKIEA WARDELLII, Perk., Engler's Bot. Jahrbücher, xxv. 570 (1898). Syn. *Mollinedia Wardellii*, F.v.M., B. Fl. Austr. v. 287.

TETRASYNANDRA PUBESCENS, Perk., Engler's Bot. Jahrbücher, xxv. 569 (1898). Syn. *Kibara pubescens*, Benth., Fl. Austr. v. 290; *Mollinedia pubescens*, F.v.M., Second Census.

TETRASYNANDRA LONGIPES, Perk., Engler's Bot. Jahrbücher, xxv. 569 (1898). Syn. *Kibara longipes*, Benth., Fl. Austr. v. 289; *Mollinedia longipes*, F.v.M., Second Census.

The genus *Mollinedia*, Ruiz et Pav., is, according to Perkins and Gilg, confined to tropical America. The species placed by Bentham under this genus are transferred partly to *Wilkiea*, F.v.M., and partly to *Levieria*, Becc. *Kibara*, Endl., is confined to the Malayan Archipelago, the Australian species being separated from it under the new generic name Tetrasynandra.

The two New South Wales genera of this group of Monimiaceæ are easily distinguished by the male flowers. *Tetrasynandra* has 4 stamens opposite the perianth-lobes, while *Wilkiea* has 8 to 14 stamens irregularly distributed in the receptacle. Both genera are described as monœcious by the authors of the 'Monograph,' a statement which we hesitate to accept as final till verified by collectors in the field.

JUNCACEÆ.

JUNCUS FILICAULIS, Fr. Buchenau, n.sp.

Road from Nimitybelle to Cooma (J. H. Maiden, December, 1896).

A densely tufted, pale-coloured, small perennial with a horizontal rhizome, and very short internodes. Stems erect, slender ($\frac{1}{2}$ to $\frac{9}{10}$ mm. in diam.), terete, grooved, 8 to 15 cm. high to the inflorescence, or 10 to 20 cm. with the erect leafy bract, the pith interrupted, star-shaped. Sheathing bracts at the base of the stem narrow, opaque, pale, striate on the back, mucronate at the apex, the highest 3 to 5 cm. long. Inflorescence apparently lateral, compound, densely crowded, nearly globular; the lowest bract erect, leafy stem-like and continuing the stem, straight or curved, 3 to 5, rarely 6 cm. long, the upper bracts shorter than the flowers, glumaceous, pale-coloured. Flowers 2½ to 3 mm. long, pale. Perianth-segments of equal length, or the inner ones distinctly shorter, lanceolate, with broad membranous margins, greenish-yellow on the back, the outer ones acute, the inner ones rather obtuse (but often acute by the involute margins). Stamens 3, scarcely half as long as the perianth-lobes; filaments white, linear; anthers yellow, longer than the filaments. Capsule obovate, obtusely trigonous, obtuse, shorter than the perianth, shining, yellowish, 3-septate. Seeds small, ferruginеous, on the base and apex, longer or shorter apiculate, regularly striped between the slightly prominent ribs.

A well-marked species, easily distinguished from all other species of the Junci genuini by the thread-like stems and by the contracted inflorescence. It is most nearly allied to *J. vaginatus*, and may at first sight be taken for a very depauperate form of it; but the small fruits, shorter than the perianth, separate it from that species.

The technical terms used by Prof. Buchenau, of Bremen, differ so much from the terminology employed by Bentham, that we have thought it desirable to give a somewhat abbreviated translation of his description, more in conformity with the descriptions used in the 'Flora Australiensis'; but in fairness to the author of the species, we here add the original description kindly sent by him in MS. and not previously published:—

JUNCUS FILICAULIS, Fr. Buch., n.sp.

Juncus e subgeneri J. genuinorum.

Perennis, dense caespitosus, pallidus. Radices filiformes, diam. usque 0·8 mm., pallide fuscae. Rhizoma horizontale, internodiis brevissimis. Caules erecti, tenues, diam. 0·5, usque 0·9 mm., teretes, valleculati, usque ad inflorescentiam 8 usque 15, cum bracteâ infimâ 10 usque 20 cm. alti, medullâ interruptâ asterisciformi repleti. Folia basilaria cataphyllinâ, angusta, opaca, pallida, dorso striata, apice mucronata, supremum 3 usque 5 cm. longum.

Inflorescentia pseudolateralis, composita, dense aggregata, fere sphaerica. Bractea infima cauliformis recta vel curvata, 3 usque 5 (raro 6) cm. longa, bracteae sequentes et prophylla hypsophyllina, pallida floribus breviora. Flores 2·5 usque 3 mm. longi, pallidi. Sepala aequilonga vel interna distincta breviora, lanceolata, late membranaceo-marginata, dorso viridiusculo-straminea, externa acuta, interna obtusiuscula (sed ob margines involutos saepe acuta). Stamina 3, dimidia sepala vix aequantia; filamenta alba linearia; antherae flavidae, filamentis longiores. Pistillum perigonis brevius; ovarium trigono-ovatum; stilus brevissimus; stigmata longa. Fructus perigonis brevior, obovatus, obtusus, obtuso-trigonus, lateribus non impressis, triseptatus; pericarpium subcoriaceum, nitidum, stramineum. Semina parva, circa 0·4 mm. longa, ferruginea, irregulariter et saepe oblique obovata, basi et apice longius breviusve apiculata, inter costas paulla prominentes regulariter transversim linea lata.

Cooma District, N.S.W. (J. H. Maiden; December, 1896).

Prof. Buchenau's views in regard to the nomenclature of the Australian Juncaceæ differ in many respects from those of Bentham and Mueller, and, as the opinion of such a well known authority on Juncaceæ will be of interest to Australian botanists, we give here a short extract from his 'Monographia Juncacearum' (1890), supplemented by his 'Studien über die Australischen Formen der Untergattung Junci genuini,' published five years later in Engler's Botanische Jahrbücher, Band xxi. Heft 3, p. 258.

AUSTRALIAN SPECIES OF JUNCUS ACCORDING TO FR. BUCHENAU'S 'MONOGRAPHIA JUNCACEARUM.'

Subgenus i.—*Junci poiophylli*, Fr. Buch.

1. *J. bufonius*, Linn.; B.Fl. vii. 127. All the colonies except West Australia.

2. *J. Brownii*, F.v.M.; B.Fl. vii. 128 as *J. revolutus*, R.Br. The specific name *revolutus* has been rejected as being based on an error; the leaves are quite flat, though in a dried state they

appear furrowed underneath on account of the shrinking of the tissue between the three strongest ribs. New South Wales, Victoria, Tasmania.

3. *J. homalocaulis*, F.v.M.; B.Fl. vii. 128. New South Wales, Victoria, South Australia, West Australia.

4. *J. tenuis*, Willd. Not recorded by Bentham and Mueller from Australia.

A slender perennial allied to *J. Brownii*, F.v.M., from which it is most conveniently distinguished by the two long leafy bracts at the base of the inflorescence which generally much exceed the inflorescence, while *J. Brownii* has a single leafy bract at the base of the inflorescence scarcely exceeding it. *J. tenuis* is so common in the Port Jackson district that it must have been collected frequently, but probably has been mixed up with *J. Brownii*, a mistake all the more likely as Bentham himself seems to have mixed up the two species in his description of *J. revolutus*. (He writes, B.Fl. vii. 128, "Flowers . . . with one or two leafy bracts at the base of the cyme").

It seems to be not truly indigenous to Australia, but this is a very difficult question to decide, especially as so many Junci are almost cosmopolitan; however, we can only say that all our specimens are from cultivated ground, and that we have not seen a specimen from beyond the Port Jackson district.

Subgenus ii.—*Junci genuini*, Fr. Buch.

The chief character of this Section of Junci is the inflorescence, which is terminal, but has quite a lateral appearance on account of the lowest bract being erect, continuous with the stem and completely simulating the stem. Bentham includes four Australian species in this group—*J. communis*, E. Mey., *J. vaginatus*, R.Br., *J. pauciflorus*, R.Br., *J. pallidus*, R.Br. Fr. Buchenau divides the Australian Junci of this group into five species, to which he now adds *J. filicaulis* as the sixth.

5. *J. filicaulis*, Fr. Buch. New South Wales.

6. *J. polyanthemus*, Fr. Buch., Engl. Bot. Jahrb. xxi. 3, p. 261 (1895).

A moderately tall green perennial chiefly characterised by its small trigonous-globular fruits (smaller than in all the following species of this group), scarcely exceeding the perianth, and by the much-compound regular dichotomously branched dense but not contracted inflorescence with numerous flowers. Flowers scarcely 2 mm. long. Perianth segments of equal length. Stamens 3.—All the Australian States.

This species much resembles in its typical form the European *J. effusus*, Linn., but is distinguished from it chiefly by the fruit and by the interrupted pith and the rather smaller flowers. In Bentham's Fl. Austr., it seems to be included in *J. communis*, E. Mey.

7. *J. radula*, Fr. Buch. Mon. Junc. p. 241 (1890).

A moderately tall pale perennial distinguished by the anthelate inflorescence (an inflorescence where the lateral axis exceeds the main axis) ending in sickle-shaped ultimate branchlets with round flowers distant at equal intervals. Stamens 3 to 6. Fruit trigonous-barrel-shaped, as long as the perianth.—New South Wales, Victoria, West Australia.

8. *J. vaginatus*, R.Br. Prod. 258 (1810); B.Fl. vii. 129.

Chiefly distinguished from the allied species by the flowers being collected in small clusters in the irregular branched inflorescence. Stamens 3 to 6. Fruit barrel-shaped, longer than the perianth.—New South Wales, Queensland.

9. *J. pauciflorus*, R.Br. Prod. 259 (1810); B.Fl. vii. 129.

A rather small plant with an anthelate inflorescence like *J. radula*, but the fruits are trigonous-ovate, about 3 mm. long, conspicuously longer than the perianth. Stamens 3 to 6. Flowers not always few as is implied in the name.—New South Wales, Queensland, Victoria, S. Australia, Tasmania.

10. *J. pallidus*, R.Br. Prod. 258 (1810); B.Fl. vii. 130.

A tall pale plant with an anthelate inflorescence. Fruit trigonous-ovate, and exceeding the perianth, but larger than in *J.*

pauciflorus, about 4 mm. long. Stamens 6.—New South Wales, Queensland, Victoria, Tasmania, South Australia, West Australia.

Subgenus iii.—*Junci thalassici*, Fr. Buch.

11. *J. maritimus*, Lam., var. *australiensis*, Fr. Buch.; B.Fl. vii. 130.—New South Wales, Queensland, Victoria, Tasmania, South Australia, West Australia.

Subgenus iv.—*Junci septati*, Fr. Buch.

This group contains all the Australian species the leaves of which are more or less distinctly jointed from internal cross partitions of the pith.

12. *J. pusillus*, Fr. Buch., Abh. Nat. Ver. Brem. vi. p. 395 (1879); *J. capillaceus*, Hook. f., Fl. Nov. Zel. i. 264 (1853), B.Fl. vii. 132.—New South Wales, Victoria, Tasmania.

Hooker's name *capillaceus* has to give way to Buchenau's name *pusillus*, because the former name has been previously bestowed by Lamarck on a South American species of Juncus. Mueller united it in his Census with the Chilian species *J. stipulatus*, Meyen and Nees, a union which is not followed in the latest Kew publication, nor by Prof. Buchenau.

Bentham's description of *J. prismatocarpus* includes *J. holoschœnus*, an unnatural union, as Mr. E. Cheel has pointed out (these Proceedings, 1902, p. 210), a view fully approved of by Prof. Buchenau.

Buchenau describes four species in this group (besides *J. pusillus*), viz., *J. prismatocarpus*, *holoschœnus*, *Fockii* and *lampocarpus*, which are all common in the Port Jackson district, and are doubtless mixed up in most Australian herbaria with *J. prismatocarpus*. To clear up the confusion, we give here a short description of the four species, extracted from Buchenau's 'Monograph,' and a short key of the most conspicuous though not always most important characters :—

1. Stamens 3. Leaves indistinctly septate, pluritubulose........ .... 13. *J. prismatocarpus*.

1*. Stamens 6. Leaves distinctly septate, unitubulose.

2. Flowers large.
  3. Flowers with acute angles, crowded. Fruit scarcely longer than the perianth............ 14. *J. holoschœnus.*
  3*. Flowers with obtuse angles, squarrose. Fruit conspicuously longer than the perianth... 15. *J. Fockii.*
2*. Flowers, flower-clusters, and fruits conspicuously shorter.................................. 16. *J. lampocarpus.*

13. *J. prismatocarpus*, R.Br., Prod. 259 (1810); B.Fl. vii. 131.

A very variable perennial. Stems erect, 20 to 50 cm. high, from nearly terete to two-edged compressed. Leaf-sheath rounded or acute at the back, the lamina mostly much compressed, indistinctly septate and pluri-tubulose, *i.e.*, the leaf has longitudinal partitions besides the indistinct cross-partitions (rarely uni-tubulose and perfectly septate). Inflorescence compound to decompound, the globular clusters few- to many-flowered (6 to rarely 12). Flowers 3 to 5 mm. long, mostly crowded, nearly always green. Perianth segments linear-lanceolate, subulate, mostly of equal length. Stamens 3, about half as long as the perianth segments; anthers oblong. Fruit as long as the perianth or more or less longer, triquetrous, conical or prismatic, shining, mostly from rust-coloured to straw-coloured.—All over Australia, New Zealand, Southern and Eastern Asia.

14. *J. holoschœnus*, R.Br., Prod. 295 (1810).

A perennial with rigid erect stems 20 to 40 cm. high, terete or somewhat compressed. Lamina of the leaves perfectly septate and uni-tubulose, *i.e.*, without longitudinal partitions, rigid, compressed, 1½ to 2½ mm. diam. Inflorescence rigid, mostly umbel-like, rarely anthelate, with 4 to 8 flower-clusters, each of about 15 to 20 crowded flowers. Flowers 3¾ to 4¼ mm. long, sharp angled. Perianth segments of equal length, lanceolate, pointed, the inner ones with membranous margins, green or greenish-straw-coloured with a brown point. Stamens 6. Fruit as long as the perianth or somewhat longer, prismatic or somewhat ovate-prismatic, shortly or very shortly mucronate, shining, rust- or straw-coloured.—Australia and New Zealand.

15. *J. Fockii*, Fr. Buch., Mon. Junc. p. 358 (1890).

A perennial with stiff erect compressed stems 20 to 40 cm. high. Leaf-sheath somewhat acute on the back, the lamina laterally compressed, perfectly septate and uni-tubulose. Inflorescence stiff, decompound, anthelate, the flower-clusters with about 8 to 10 squarrose flowers. Flowers 4 to 4½ mm. long or with mature fruits attaining to 6 mm., blunt-angled. Perianth segments of equal length, or the inner ones longer, green or the apex reddish. Stamens 6. Fruit conspicuously longer than the perianth, narrow prismatic-pyramidate, gradually narrowed from near the base, shining, rust- or straw-coloured.—Australia.

16. *J. lampocarpus*, Fr. Buch.

A somewhat cæspitose perennial. Stems 5 to 25, rarely 45 cm. high, either erect and terete or ascending and compressed. Lamina of the leaf terete or compressed, often curved, perfectly septate and one-tubed. Inflorescence mostly with numerous flower-clusters, anthelate, the branches oblique-erect, the ultimate ones often squarrose. Flowers few or rarely numerous in the cluster, 2½ to 3 mm. long. Perianth segments of equal length, mostly all acute, the inner ones rarely obtuse. Stamens 6. Fruit longer than the perianth, ovate, prismatic-pyramidate, shortly mucronate, shining, black or brown, rarely rust-coloured or greenish.

Common in Europe and Asia, less common in North America, Northern Asia and New Zealand. No Australian localities have been hitherto recorded for this species, but it is common in swampy places in the Port Jackson district; and we have also a specimen from South Australia. We have to thank Prof. Buchenau for the determination of our specimens.

Subgenus v.—*Junci graminifolii*, Fr. Buch.

17. *J. falcatus*, E. Mey.; B.Fl. vii. 126.—New South Wales, Victoria, Tasmania.

18. *J. planifolius*, R.Br.; B.Fl. vii. 125. All the Colonies except West Australia.

19. *J. gracilis*, R.Br.; B.Fl. vii. 125.—West Australia.

20. *J. caespiticus*, E. Mey.; B.Fl. vii. 126 as *J. caespitius*, E. Mey.—New South Wales, Victoria, Tasmania, South Australia, West Australia.

21. *J. capensis*, Thunb., var. *Ecklonii*, Fr. Buch.

A perennial with fibrous roots and erect slender stems, about 30-35 c.m. high. Leaves linear, narrow, involute. Inflorescence terminal, compound, anthelate or umbel-like, the lowest bract leafy, as long as the inflorescence, the others shorter. Flower-clusters 10 to 15, with 6 to 10 flowers about 4 mm. long; perianth segments mostly aristate-acuminate.

A South African plant collected by Mr. E. Cheel in the Centennial Park, Sydney, December, 1900. Determined by Prof. Buchenau.

TYPHACEÆ.

In P. Graebner's recent Monograph of the Typhaceæ (Engler, "Das Pflanzenreich," iv. Typhaceæ, 1900) the following two forms are recorded for New South Wales.

TYPHA ANGUSTIFOLIA, Linn., Spec. Pl. ed. 1, p. 971 (1753).

Var. *Brownii*, Kronfeld, Verh. Zool. Bot. Ges. Wien, xxxix. p. 152 (1889). Syn. *J. latifolia*, Forst. f., Fl. Ins. Prod. 64 (1786); *J. angustifolia*, R.Br., Prod. 338 (1810).

Lower leaves with a semi-cylindrical sheath, rarely flat. Upper male portion of the spike often contiguous with the lower female portion. Hairs in the axils of the male flowers dilated towards the apex, not denticulate. Bracteoles gradually dilated towards the apex.—Port Jackson district.

Var. *Muelleri*, Rohrb., Verh. Bot. Ver. Brandenb. xi. p. 95 (1869). Syn. *J. angustifolia*, Hook. f., Fl. Tasm. ii. 38 (1860).

Leaves biconvex at the base. Upper male portion of the spike separated from the lower female portion by a bare interval, or rarely contiguous. Hairs in the axils of the male flowers simple or branched. Filiform bracteoles abruptly dilated at the apex.

Scattered in New South Wales. No special locality given, but as it is recorded from Central Australia, the western specimens belong probably to this form.

SCHEUCHZERIACEÆ.

The genus *Triglochin* is placed by Bentham and Hooker in the very heterogeneous order Naiadaceæ, which contains plants of such different structure that they have hardly anything in common but their aquatic habit. In accordance with the nomenclature followed in Engler's 'Nat. Pflanzenfamilien,' the artificial order Naiadaceæ has been split into several smaller natural orders, viz.:—Potamogetonaceæ, Najadaceæ and Juncaginaceæ, the genus *Triglochin* belonging to the last-named order. In Fr. Buchenau's latest Monograph in Engler's 'Pflanzenreich" (1903), the name of the order Juncaginaceæ has been changed into Scheuchzeriaceæ, and so many changes have been made in restoring old names to specific rank (merged by Bentham and Mueller into other species), that it will be of interest to Australian botanists if we give here a short extract of Prof. Buchenau's views on the Australian Scheuchzeriaceæ.

KEY TO THE AUSTRALIAN GENERA OF SCHEUCHZERIACEÆ.

1. Ovule erect.. .... 1. *Triglochin*, Linn.
1*. Ovule pendulous..................... .... 2. *Maundia*, F.v.M.

KEY TO THE AUSTRALIAN SPECIES OF TRIGLOCHIN.

i. Subgenus *Eutriglochin*; carpels connate, separating at maturity from the central axis, the apices sometimes free. Fertile carpels 3 in the Australian species.

1. Perennial plants with persistent stolons. Carpels semicircular, obtuse at the base. 1. *T. striata*, Ruiz, et Pav., Fl. Peruv. et Chil. iii. (1802) 72; B.Fl. Austr. vii. 166.—All the Colonies except West Australia.

1*. Small annual plants.

  2. Carpels free at the apex, the fertile ones with a reflexed point at the apex. 2. *T. mucronata*, R.Br., Prod. (1810) 343; B.Fl. Austr. vii. 168.—W.A., S.A., Vic.

  2*. Carpels straight, connate to the apex.

    3. Fruits elliptical, very small (hardly 2 mm. long), carpels rounded at the base and at one back. 3. *T. Muelleri*, Buch., Pflanzenreich iv. 14 (1903), p. 12.—W.A.

    3*. Fruits linear, carpels more or less spurred at the base.

4. Fruits pyramidal-linear, somewhat spreading, pedunculate or sessile; carpels rounded at the back, the spurs long and often curved.—4. *T. calcitrapa*, Hook., Ic. Pl. viii. (1845) t. 731 (*T. centrocarpa*, Hook. var. *calcitrapa*, Benth., Fl. Austr. vii. 167).—W.A., S.A., N.S.W., Q.

4*. Fruits prismatic-linear.

5. Fruits pedunculate, spreading; carpels laterally carinate, the spurs very short.—5. *T. nana*, F.v.M. in Trans. Vict. Inst. i. (1854) 135 (*T. centrocarpa*, Hook., var. Benth., Fl. Austr. vii. 167).—Vic., Tas., S.A.?

5*. Fruits sessile.

6. Fruits rather long (3½ to 5 mm. long), appressed; carpels laterally carinate, the spur short.—6. *T. centrocarpa*, Hook., Ic. Pl. viii. (1845) t. 728; B.Fl. Austr. vii. 167.—*T. centrocarpa*, Hook., a rare plant, according to Fr. Buchenau, growing in W. Australia in crevices of rocks between moss. The additional localities: S. Australia, Tasmania, Victoria, N.S. Wales, Queensland, given by Mueller in his Census, refer apparently to *T. nana* and *T. minutissima*, both included by Mueller and Bentham in this species.

6*. Fruits very small (1 to 1½ mm. long), somewhat spreading; carpels hardly carinate, the spur very short.—7. *T. minutissima*, F.v.M., Fragm. vi. (1867) 82 (*T. centrocarpa*, Hook. var. Benth., Fl. Austr. vii. 167).—Southern parts of Australia.

ii. Subgenus *Cycnogeton*. Carpels all free. Very variable, perennial, mostly floating.—8. *T. procera*, R.Br., Prod. (1810) 343; B.Fl. Austr. vii. 168. —Common all over Australia.

MAUNDIA, F.v.M.

M. triglochinoides, F.v.M., Fragm. i. (1858) 23 (*Triglochin Maundii*, F.v.M., Fragm. vi. 83; B.Fl. Austr. vii. 169).—New South Wales, Queensland.

CYPERACEÆ.

SCHŒNUS SCULPTUS, Boeck.

Near Germanton (W. Forsyth; November, 1900), near Grenfell (Collector unknown; February, 1901). New for New South Wales.

The type of this species was collected by Drummond in Western Australia; Mueller gives, in his Second Census, South Australia as an additional locality; Mr. H. B. Williamson collected it in 1901 at Hawksdale, Victoria, and we are now able to add it to the flora of New South Wales.

GRAMINEÆ.

PANICUM GILESII, Benth.

Coonamble (L. J. Ffrench; February, 1903).

This Central Australian grass was first recorded for New South Wales in these Proceedings for 1901 (p. 89) from specimens sent from Tibooburra, in the extreme north-west corner of this State. Now it is recorded from Coonamble on the Castlereagh River about 100 miles north of Dubbo, where it is said by Mr. Ffrench to thickly cover about ¼ of an acre in a paddock of the Geanmoney Station, though it is supposed to have been previously quite unknown in the district.

FILICES.

PTERIS FALCATA, R.Br., var. NANA, Bailey.

Grose Vale, near Mt. Victoria (E. Cheel; December, 1900); Crawford River, Bullahdelah (E. Cheel; October, 1902).

Two new localities for Bailey's var. *nana* of *Pteris falcata*, which has been previously recorded by us from the Apsley Falls, New England.

DESCRIPTION OF A NEW GENUS AND SPECIES OF COLEOPTERA (FAMILY *HISPIDÆ*) FROM NEW BRITAIN.

By David Sharp, M.B., F.R.S.

(Communicated by W. W. Froggatt.)

Brontispa, n.gen. *Chrysomelidarum (Hispides*, Group *Cryptonychites.)*

Corpus perelongatum, depressum. Caput inter antennas productum, acuminatum, medio canaliculatum. Elytra regulariter seriatim punctata, interstitiis æqualibus, nullo modo costatis.

This genus may be placed between *Cryptonychus* and *Oxycephala*. The simply acuminate spinose projection on the front of the head, and the remarkably even surface (very regularly punctured) of the extremely elongate elytra, are sufficient to distinguish it. It has another remarkable character: on the under surface of the head, the parts of the mouth are not closely applied to the front of the prosternum, but are separated from it by a curved ridge running all across the head in correspondence with the curve of the front of the prosternum.

BRONTISPA FROGGATTI, n.sp.

Elongata, depressa, subparallela, rufotestacea, elytris nigrosuffusis, interdum fere totaliter rufo-testaceis, interdum omnino nigris, corpore subtus plus minusve nigro-suffuso; antennis elongatis nigricantibus. Long. 9 mm., cap. ¾, thor. 1½, elytris 6¾-7 mm.; lat. 2 mm.

Colour reddish-yellow, suffused with black to a variable extent, but with the prothorax always in larger part red. Antennæ 2¾ mm. long; the terminal four joints closely articulated, elongate, dull, the other joints shining, with the sutures between them distinct. Thorax about as long as broad, at the sides the outline is a little incurved, the margins excessively fine; there are numerous coarse punctures on it, but there is also a large angular smooth space extending all across it. Elytra with very regular series of deep punctures; just about the middle the 5th and 6th series diverge so as to allow two additional series to be intercalated behind this spot. Under surface polished and shining.

Oxycephala longissima, Gestro, from Aru, is nearly as elongate as *B. froggatti.*

A number of specimens of this beetle were received from Mr. J. G. O'Malley, manager of Kukada Plantation, New Britain, with the information that they were a very serious pest. He says:—"If something cannot be done to abolish or check this plague, I fear many thousands of acres of young palms will be destroyed. The insect deposits its eggs upon the young shoots of the plant upon which the larvæ feed. There are fully 50,000 plants ravaged by this pest."

SUR QUELQUES SIMILITUDES DES LANGUES ET DES COUTUMES DES INDIGENES DE FUNAFUTI (ELLICE GROUP) ET DES INDIGENES DES ILES DE LA SOCIETE, DE L'ARCHIPEL DES TUAMOTU, ETC.

PAR MM. DONAT ET SEURAT.

(Communicated by C. Hedley, F.L.S.)

La langue et les coutumes des Indigènes (natives) du groupe des Ellice présentent avec celles des Indigènes de la Polynésie orientale (Iles Tahiti, Tuamotu, Gambier, &c.) des similitudes qui nous permettent, jusqu'à un certain point, de saisir les affinités qui existent entre ces différents peuples. Nous nous proposons, dans ce qui va suivre, d'indiquer ces analogies en nous reférant du remarquable travail de Mr. Charles Hedley, "The Atoll of Funafuti" (Sydney, 1896-1900).

Tabu.—La coutume de réserver un Cocotier (*Cocos nucifera*, L.) en y suspendant un fruit ou une feuille, appelée "*Niu tabu*" aux Ellice (Hedley, pages 26 et 27, fig. 2) existe également à Tahiti, aux îles Tuamotu, Gambier et Marquises, où elle est connue sous le nom de *tabu.*[*] Les Indigènes des îles Tuamotu (Paumotu) réservent un Cocotier en attachant, sur le tronc à quatre mètres de hauteur, des feuilles vertes ou desséchées de cet arbre. Les Tahitiens se servent, pour réserver un arbre à pain (*Artocarpus incisa*, L.) d'une branche de cet arbre qu'ils amarrent au pied; pour réserver un Cocotier, ils emploient une feuille de Cocotier, ou bien ils attachent, au pied de l'arbre, trois ou quatre feuilles sèches de Bananier.

Plantes.—Le mot "*Niu,*" employé par les Indigènes de Funafuti pour désigner le Cocotier, est également employé, pour désigner le même arbre, par les Indigènes des îles Tuamotu.

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[*] Les Mangaréviens désignent cette coutume sous le nom de "*rahui.*"

Le "*Nonou*" des habitans de Funafuti (*Morinda citrifolia*, Linn.) est désigné sous le nom de "*Nono*" par les Tahitiens et les Mangaréviens.

Cette plante existe à Tahiti, aux îles sous- le vent, et dans les archipels des Tuamotu, des Gambier, Tubuai et Cook. Les Indigènes de Tubuai et des îles Cook se servent de la racine du Nono, mélangée avec de la chaux fabriquée avec du corail, pour teindre les nattes en rougeâtre. A Tahiti on ne s'en sert plus; les Tahitiens, autrefois, se servaient plutôt de l'écorce du "*fei*" (*Musa fei*) pour teindre leurs nattes.

La racine du "*Ti*" (*Cordyline terminalis*, Kunth) est cuite au feur et mangée par les Tahitiens; autrefois, ils faisaient une boisson avec la racine. Les Mangaréviens mangeaient également cette racine quand les vivres manquaient.

Costumes.—Le "*Maro*" en langue tahitienne primitive, en pomotu, en langue de Rurutu, désigne une ceinture faite avec diverses écorces d'arbres entrelacées de plumes d'oiseaux de différentes couleurs. D'autres ceintures sont simples et ne comportent pas de plumes d'oiseaux. Ce mot "*maro*" n'est plus employé par la nouvelle génération.

Le couvre-œil (Eye-shade), a été employé anciennement à Tahiti; actuellement on rencontre encore quelques vieilles femmes qui s'en servent, mais cet usage disparaîtra sous peu. Ce masque, fabriqué avec des feuilles vertes de Cocotier tressées est destiné à préserver les yeux du soleil.

Pêche (Fishing).—(*a*) Hameçons (Hooks). Les Tahitiens n'emploient plus les anciens hameçons, sauf l'hameçon en nacre pour la pêche de la Bonite en pleine mer. Les habitants des îles Tuamotu ont conservé l'hameçon en nacre pour la pêche de la Bonite; seuls, les habitants de Napuka (14° 12′ lat. Sud; 143° 28′ W. [Paris]) et de Fagatau (19° 92′ lat. Sud; 143° 14′ W.) ont conservé les hameçons en bois et en écaille de tortue.

Les Tahitiens placent, à l'extrémité de l'hameçon en nacre, une houppe faite avec des soies de porc; les habitants des Tuamotu se servent d'une plume de Frégatte (Frigate-bird).

Les habitants de Tubuai ont conservé l'usage d'un hameçon en bois pour la pêche d'un poisson appelé *uravena*, qui vit dans les fonds de 300 à 400 brasses, et dont la chair est excellente, quoique produisant une légère dyssenterie.

(*b*) Appâts (Baits). Les Indigènes des îles Tuamotu et Gambier emploient de préférence, comme appât, l'abdomen du *Cœnobita perlata*, Edw., Crustacé qui habite les coquilles vides de *Turbo setosus*, Gmelin, et se trouve en abondance au pied des *Pandanus*. Ce Pagure, appelé "*Ounga Koula*" par les Indigènes de Funafuti est appelé Uga (prononcez Ounga) par les Indigènes des Tuamotu et des Gambier, "*Uá*" par les Tahitiens. (Le mot "*Koura*" signifie rouge, en langue pomotu).

Les Indigènes des Tuamotu se servent également de l'encre des Céphalopodes : ils la font sécher au soleil sans l'imbiber dans le petrole, et s'en servent comme amorce pour les Poissons à bouche petite. Cette pêche est inconnue à Tahiti.

Il y a une quarantaine d'années, les Tahitiens se servaient du fruit du "*Hutu*" (*Barringtonia speciosa*, Forst.) pour endormir le poisson; actuellement cette pêche est abandonnée complètement, sauf aux Marquises.

Pêche à la Tortue.—Les tortues marines sont abondantes dans un certain nombre d'îles de l'archipel des Tuamotu : Napuka, Fagatau, Fakahina, Tatakoto, Pukaruha, Reao, Vahitahi, Tikei, Tepoto, Matahiva.

Les Indigènes savent que la saison des tortues est arrivée (Octobre et Novembre) quand le groupement des six étoiles qu'ils appellent *matari* se lève à l'Est.

Ils veillent sur la plage et, quand une Tortue est signalée, ils sautent à la mer en emportant avec eux vingt-cinq brasses de corde fabriquée avec l'écorce du coco, cette corde portant à son extrémité un crochet à l'aide duquel ils saisissent la tortue entre le cou et le membre antérieur; sitôt qu'elle est prise, le plongeur saisit la tortue par les deux membres antérieurs et lui fait prendre une direction presque verticale, en appuyant sur l'arrière : la tortue monte à la surface et alors un ou plusieurs individus s'emparent de la ligne et nagent vers les récifs où l'animal est finalement hâlé. Les meilleurs pêcheurs amènent la tortue sur le rivage sans se servir de la ligne.

Les Indigènes sont très friands de la viande de cet animal; avant l'introduction du christianisme dans les iles Tuamotu, les femmes n'avaient pas le droit d'en manger.

Mollusques comestibles.— Les Indigènes des Tuamotu et des Gambier sont très friands de la chair de l'Huître perlière (*Margaritifera margaritifera* var. *Cumingi*, Reeve) et surtout du muscle adducteur; ils mangent également les Chames (*Chama pacifica*, Brod.), les "*Maua*" (*Turbo setosus*), les Pterocères, les Modioles (*Modiola australis*, Gray) et le *Vermetus maximus.*

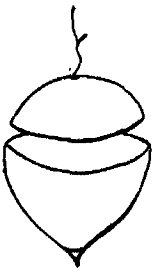
Les Mangaréviens mangent le Poulpe (*Octopus*) crû de préférence; ils le font sécher pendant la saison; les indigènes des Tuamotu les fûment et les font ensuite sécher au soleil.

La râpe des Indigènes de Funafuti faite d'une peau de raie appliquée sur un morceau de bois (Hedley, p. 259, fig. 21 et 22) est connue à Tahiti: les Tahitiens s'en servent pour râper le bois de sandal (*Santalum insulare*) pour la fabrication du *monoi* (huile parfumée).

Les Indigènes de Tahiti et même les Européens, emploient pour râper le coco, un instrument en fer, monté sur un support. Le système primitif est abandonné : les Indigènes se servaient, soit d'un morceau de nacre présentant à l'extrémité des indentations formant une scie, soit d'un morceau de corail dur. Les Indigènes des Pomotu se servent souvent d'un fragment de noix de coco taillé en scie.

Jeux.—Les enfants tahitiens savent faire le moulin à vent en feuilles de cocotiers en usage à Funafuti (Hedley, p. 304, fig. 80). Aux îles Tuamotu, les enfants se servent des Cônes (*Conus hebraeus*) en guise de toupies. Les enfants Mangaréviens fabriquent des toupies avec le fruit du "*miro*" (*Thespesia populnea*, Corr.), enfilé dans un petit morceau de bois.

Le jeu favori des jeunes Mangaréviens est le lancement de petits bateaux en bois de "*purau*" (*Hibiscus tiliaceus*), armés en goëlette, les voiles etant formées d'un fragment de feuille de cocotier enfilée dans les mâts; ils lestent ce bateau à l'aide d'une tige de fer qui traîne à l'arrière et orientent les voiles suivant la direction du vent.

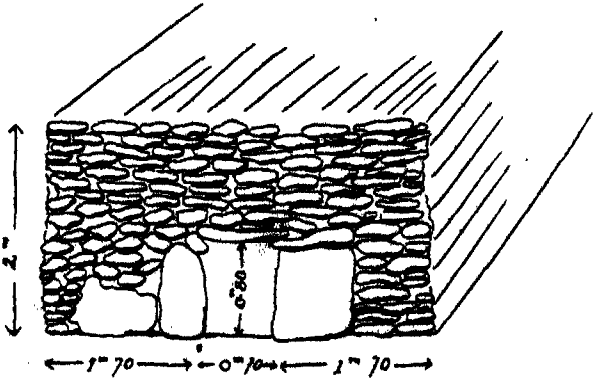


Les enfants de Mangareva découpent, dans la noix de coco, une calotte et font passer, à travers le trou germinatif, une corde en *nape* (bourre de la noix de coco) de 1 mètre de longueur, qui suspend la calotte; saisissant la corde entre le pouce et le second doigt du pied, ils marchent à l'aide de cette sandale d'un nouveau genre, et font un bruit qui rappelle celui du pas des chevaux; ils tiennent les cordes à la main, de façon à maintenir le noix en place.

Divinités.—Le "*marae*" en usage à Funafuti, signifie "autel de faux Dieux" en tahitien, en pomotu, en langue de Tubuai et en langue des îles Cook.

Il existe encore cinq de ces autels ou marae à la pointe N.E. de l'île Timoe ou Crescent, située à 29 milles au S.E. de Mangareva. Ces autels sont établis sur la crête de l'île, formée en cet endroit par une accumulation de blocs de Madrépores.

Le plus grand de ces autels a la forme d'un parallélipipède rectangle mesurant 4 mètres de largeur, 6 mètres de longueur et 2 mètres de hauteur; il est formé de blocs plats de Madrépores superposés régulièrement; sur la façade (fig.) on trouve un orifice



Marae—vue du côté de l'entrée.

encadre par des blocs plus grands, placés debout, au lieu d'être à plat, ouverture qui mène dans une chambre ayant 1 mètre de profondeur; au milieu des blocs de Madrépores, on trouve quelques ossements humains. Des sentiers en blocs de Madrépores mènent à ces autels (Seurat).

Le mot "*Fale atua*" qui signifie temple en laugue de Funafuti, signifie "Maison de Dieu" en tahitien (Fare Atua). "Tangaloa," Dieu du Ciel et principale Divinité de la Polynésie, des Indigènes de Funafuti, est "Tangaroa" des indigénes de l'archipel des Tuamotu et de l'archipel des Gambier, qui la consideraient comme le Génie ou la Déese de ces îles.

THE BOTANY OF THE "CLEARS" AND "BASALT MASSES," COUNTY OF HUNTER, N.S. WALES.

By A. C. Barwick.

(Communicated by R. T. Baker, F.L.S.)

There is a remarkable feature in the botany of this county that, as far as I have been able to ascertain, has never yet been recorded. I refer to the "Clears." In certain parts of the county there is found to exist, or rather perhaps flourish, a flora, which, if not entirely distinct, yet differs so considerably from that of the surrounding country that it must be regarded as differentiating from it in a marked degree.

This characteristic vegetation has given rise amongst the local residents to the term "Clears," which name is applied by them to denote not only this peculiar or distinctive flora, but also the particular rich volcanic soil upon which it thrives. When I state that there is an absence of undergrowth of bushes and shrubs such as pertains in the neighbouring bush, the meaning of the word is apparent.

Grass, however, is abundant, and consequently these specially favoured localities are in much request for pasturing and other purposes. These "Clears" and "Basalt Masses" are situated in the parishes of Putty, Tupa, Parry, Gullongulong, Tollagong, Myrtle and Wareng, and lying between 32° 50′ and 33° 5′ S. lat., and between 150° 35′ and 150° 55′ E. long.; and, as far as I have been able to enumerate them, are as follows:—(1) Clear Farm, (2) Jacob's Hollow Clear, (3) Boxy or Box Tree Clear, (4) Little Clear, (5) Putty Hill, which I am informed is also called Mt. Gullongulong, (6) Condon Clear, (7) Box Bump, (8) Green Hills, and (9) Mt. Kinderun. The plants listed in this paper were collected from all the above volcanic formations except Mt. Kinderun and Green Hills, which I have not yet had an opportunity of visiting.

The list of grasses is poor (only one species being identified) because more time has been devoted to the collecting of other species.

On approaching one of the "Clears," one is at once struck by the marked difference between the growth of the vegetation on it and that on the adjacent sandstone country, and by the absence on the volcanic soil of species growing in profusion on the sandstone, as well as by the comparative rarity of a certain species of Eucalyptus on the sandstone which is always present on the Clears, *i.e.*, *E. hemiphloia*, F.v.M.

The "Clears" are covered with a dense growth of grass upon which stock fatten rapidly. This dense growth of grass is absent on the sandstone ridges, and not so plentiful on the flats, especially those situated at a distance from the Clears.

On the sandstone ridges the Eucalypts do not attain to the same height or girth as the same species growing on the basalt, or on the flats immediately adjacent to the basalt, and which receives the decomposed volcanic matter from it.

In a former paragraph I referred to the absence of certain plants occurring on the Clears and Basalt Masses which are common on the sandstone, and I think it would not be out of place to mention the more important; for instance—*Eucalyptus eximia*, Schauer., *E. Rossi*, Baker & Smith, *E. piperita*, Sm., *E. punctata*, DC., *Angophora lanceolata*, Cav., various species of *Melaleuca*, *Leptospermum*, *Backhousia*, *Daviesia*, the various Proteaceous plants, such as Hakea, &c. Several species of the Natural Order Epacrideæ, which flourish on the sandstone ranges, disappear immediately the basalt is met with. *Oxylobium trilobatum*, F.v.M., *Gompholobium latifolium*, Sm., and *Bossiæa heterophylla*, Vent, also are absent.

It appears that Clears and Basalt Masses are factors for good in any district in which they occur, as is instanced in this district by the produce raised from farms situated on, and close to them being in excess of that of others situated farther from them.

I make no pretensions as to the completeness of this list, but I believe it to contain by far the greater number of species growing on the volcanic formations, the Natural Order Gramineæ perhaps excepted.

The geological formation of the ranges is Triassic or Hawkesbury Sandstone, with probably Pleistocene volcanic rocks, as I am informed by Mr. J. E. Carne, F.G.S.; and the geological age and origin of these "Clears" is, I understand, now being investigated by that gentleman, the results to be published by him in the Records of the Geological Survey, New South Wales; and when this information is available, the subject of this paper will be still more interesting, as the relationship, so to speak, that is found to exist between the geology and flora of this part of the county will be more apparent.

One result of these botanical notes on the "Clears" is that it shows how particular species have a penchant for special geological formations, and that although there exists land-connection between the several Clears, yet the respective species, although common to both, are absent from the intervening ground.

It is to the disintegration of the basalt from the volcanic outcrops that the valleys owe what fertility they possess, and those parts which lie closest to the Clears and Basalt Masses possess greater fertility than those farther removed.

I desire to tender my sincere thanks to Mr. R. T. Baker, F.L.S., &c., Curator of the Technological Museum, Sydney, for many kind hints and suggestions in identifying the species collected by me, and for his kindness in many other ways; and to Mr. J. E. Carne, F.G.S., Assist. Government Geologist, for information as to the formation of the ranges in the county, and for his kindness in lending me a map of the district. I must also thank Messrs. A. E. Cobcroft and L. Barnes, local residents, for accompanying me in my botanical expeditions.

I have followed Bentham's classification as nearly as I possibly could.

Class i. DICOTYLEDONS.

Subclass i. POLYPETALÆ.

Series i. **Thalamifloræ.**

1. RANUNCULACEÆ.

Clematis glycinoides, DC. This species is not very common on the Clears or Basalt Masses, but it is very common in the valleys between the sandstone ranges. Flowering period, July and August.

Ranunculus lappaceus, Sm. This is perhaps the most common of all Buttercups on the Clears; it is also common on the sandstone. October to April.

R. **rivularis**, Banks & Sol. This was only found on the Clears in one place—Condon Clear—but is very common in Putty Creek.

R. **hirtus**, Banks & Sol. December to March.

DILLENIACEÆ.

Hibbertia diffusa, R.Br. Not common on the Clears, but very common on the sandy flats. This is the only species of this genus I have seen on the volcanic formation, though such species as *H. acicularis*, F.v.M., and *H. pedunculata*, R.Br., occur on the sandstone.

VIOLARIEÆ.

Viola betonicifolia, Sm. This species is not as common on the basaltic formation as on the sandstone. April to June.

V. **hederacea**, Labill. Common on the Clears in moist places. July.

PITTOSPOREÆ.

Bursaria spinosa, Cav. Rare on the basalt, but very common on the sandstone, where it is a pest. January to March. I have noticed that specimens growing on Darkey Creek, Bulga, reach a height of over 20 feet, and have large leaves; while those here rarely exceed 9 feet.

BILLARDIERA SCANDENS, Sm. Rare on the basalt, fairly common elsewhere. December.

HYPERICINEÆ.

HYPERICUM JAPONICUM, Thunb. Common on the Clears, but more common on the sandy flats. The specimens on the Clears are generally larger than those of the sandstone country. November to May.

Series ii. **Discifloræ**.

GERANIACEÆ.

GERANIUM DISSECTUM, Linn. Common on the Clears, also on the sandstone. Sometimes seen upon the Basalt Masses. October to May.

PELARGONIUM AUSTRALE, Willd. Common on both formations. March and April.

OXALIS CORNICULATA, Linn. Common on both sandstone and "Clears"; but specimens on the "Clears" have generally larger leaflets. October to May.

RUTACEÆ.

BORONIA POLYGALIFOLIA, Sm. Not so common on the Clears as on the sandstone. April.

ACRONYCHIA LÆVIS, Forst. Rare; only two plants seen at Clear Farm. In fruit in January.

STACKHOUSIEÆ.

STACKHOUSIA MONOGYNA, Labill. (*S. linariæfolia*, A. Cunn). Fairly common on Condon Clear. October.

Series iii. **Calycifloræ.**

LEGUMINOSÆ.

JACKSONIA SCOPARIA, R.Br. Rare on the basalt; very common on the sides of the sandstone ranges. This species is placed provisionally under this name in the absence of pods which I was unable to obtain at the time. October and November.

Pultenæa retusa, Sm. Rare on the basalt, but very common on the sandstone ranges. May and June.

Zornia diphylla, Pers. Common on the Clears—at least on Condon Clear. October to February.

Desmodium varians, Endl. October to March.

Glycine clandestina, Wendl. Common on both basalt and sandstone formations. October to April.

Kennedya rubicunda, Vent. Rare on the basalt; common on the sandstone. September to November.

K. monophylla, Vent. (*Hardenbergia monophylla*, Benth.). Mr. Maiden, in his "Flowering Plants of N.S. Wales," gives: "Leaflets 2, 3, or even 4 inches"; but the leaflets on a specimen found by me here measured nearly 6 inches.

Acacia melanoxylon, R. Br. Occurs on both volcanic and sandstone formations.

A. longifolia, Willd. Condon Clear. There are differences in plants growing on the Clears and others I have seen in a valley, near the 45-mile post, on the road from Warkworth to Putty. Those of Condon Clear have looser spikes, paler phyllodia, and lighter-coloured bark than the others. It is a rare species here. June and July.

A. viscidula, A. Cunn. This plant, a shrub about 9 feet high, was found on Box Bump, and I have never seen it anywhere else in this district. The phyllodes are viscid, and glandular-dotted.

A. decurrens, Willd. Locally called "Black Wattle."

DROSERACEÆ.

Drosera auriculata, Backh. Not common on the Clears, but common on the sandstone country. July.

MYRTACEÆ.

Angophora intermedia, DC. Rare on the Clears, but very common on the sandstone country. A splendid stand-by in drought, as fodder. November to January. Some of the trees flower later than others.

Eucalyptus capitellata, Sm. Called by some of the settlers "Messmate." The timber is used, though not to the same extent as *E. eugenioides*, Sieb. Not common on either formation. Fruits and buds in November.

E. siderоxylon, A. Cunn. A few specimens of this tree were found on Little Clear, though it grows plentifully on the sandstone ridges overlooking all the other Clears. I may as well state that Little Clear is hardly a Clear in the same sense as Condon Clear, being more like the Basalt Masses, *e.g.*, Box Bump.

Mr. R. T. Baker, F.L.S., writes of this species:—"Your specimen is remarkable for the pronounced angularity of the calyx." This angularity is particularly noticeable in the fruits. February to June.

E hemiphloia, F.v.M. This is the Eucalypt most in evidence on the Clears and Basalt Masses, and it is from this fact that such names as Box Clear and Box Bump are applied. I have seen this tree growing at Bulga, 13 miles from Singleton, but those growing here on the basalt are of greater height and girth than the Bulga specimens. I have only seen it growing here in one place off the basalt, and that was only a very small area, perhaps two or three acres; however, sometimes it is carried for a short distance on to the neighbouring sandstone, but perhaps these portions may have had volcanic soil on them at some former period.

This is the only Box I have seen on the volcanic formations, though I have observed two others growing on the sandstone—one, *E. Fletcheri*, R. T. Baker, growing near Clear Farm, though not actually on the basaltic formation.

E. siderophloia, Benth. Rare on the Basalt Masses, but more plentiful on the sandstone. Buds and fruit in March.

E. crebra, F.v.M. The commonest Ironbark on the sandstone, but in fewer numbers on the basalt.

E. TERETICORNIS, Sm. This species comes next to *E. hemiphloia*, F.v.M., as regards numbers found on the Clears, and even on the Basalt Masses. It is very common on the sandstone, but I believe the basalt specimens are superior to those found on the flats. There are two forms, but I believe the form with the long-pointed operculum predominates.

E. SALIGNA, Sm. Rare on the Clears, a few only being seen on the lowest levels. In the gullies and flats between the sandstone ranges two forms are to be seen, called by the settlers "Blue-gum" and "Round-leaf." These can easily be separated in the field. A settler, with many years' experience amongst timbers, informed me that the "long-leaved" form is the better timber; in fact, the "round-leaf" is rarely used. Some call the round-leaved form "Yellow Jacket."

EUCALYPTUS EUGENIOIDES, Sieb. The most common of all Stringybarks on both formations, though upon the sandstone it occurs more plentifully than upon the basalt.

From this list of Eucalypts it will be seen that very few species of that large genus occur on the basalt formation, and the species found on one Clear or Basalt Mass are almost certain to be found on all the others.

E. hemiphloia, associated with *E. tereticornis*, is more in evidence than all the rest put together. It seems to be a constant character of the Clears and Basalt Masses to grow the two species above mentioned in profusion.

Though there are only eight species in this list, yet I have collected about 22 in the district up to the present time.

ONAGRARIEÆ.

EPILOBIUM GLABELLUM, Forst. Common on the Clears. November to January.

UMBELLIFERÆ.

TRACHYMENE INCISA, Rudge. Rare on the Clears, but very common on the sandy flats. December to February.

Subclass II. MONOPETALÆ.

LORANTHACEÆ.

LORANTHUS CELASTROIDES, Sieb. December and January.

L. PENDULUS, Sieb. March.

RUBIACEÆ.

OPERCULARIA DIPHYLLA, Gaertn. Not common on the volcanic formations. December to March.

POMAX UMBELLATA, Sol. Not so common on the basalt as on the sandstone.

COMPOSITÆ.

CALOTIS DENTEX, R.Br. December to February.

BRACHYCOME MULTIFIDA, DC. December and January.

SIEGESBECKIA ORIENTALIS, Linn. Not so common on the basalt as on the sandstone. I have observed very small insects caught by the glandular hairs on this plant. December to March.

CRASPEDIA RICHEA, Cass. Common. December to April.

PODOLEPIS ACUMINATA, R.Br. Rare on the Clears, but very common on the sandy flats.

STYLIDEÆ.

STYLIDIUM GRAMINIFOLIUM, Swartz. This species generally has longer leaves on the Clears than on the sandstone.

GOODENIACEÆ.

GOODENIA HEDERACEA, Sm. January to April.

CAMPANULACEÆ.

LOBELIA PURPURASCENS, R.Br. Very common on both formations. December to May.

WAHLENBERGIA GRACILIS, DC. Very common on the Clears, also on the flats between sandstone ranges. The corolla in the sandstone specimens is often very small, and almost white; while I have not yet seen this form on the Clears. September to April.

ASCLEPIADEÆ.

TYLOPHORA BARBATA, R.Br. In Moore's 'Flora' the habitat of this species is given as "Coast District and Dividing Range from Port Jackson to Victoria." Very common in gullies close to the Clears, though rare on the Clears themselves.

BORAGINEÆ.

CYNOGLOSSUM AUSTRALE, R Br. Not as common on the Clears as on the sandstone country. December to May.

CONVOLVULACEÆ.

(?)**CONVOLVULUS MARGINATUS**, Poir. Rare. December. Placed under this species until more material can be obtained to have it properly identified.

CUSCUTA AUSTRALIS, R.Br. Common on both volcanic and sandstone formations in moist places. November to February.

SOLANEÆ.

SOLANUM AVICULARE, Forst. Very rare on the Clears; absent altogether on the Basalt Masses, but very common on the low land lying between Condon Clear and Box Bump.

DUBOISIA MYOPOROIDES, R.Br. Rare on the Clears, but very common on sandy flats near Putty Creek.

BIGNONIACEÆ.

TECOMA AUSTRALIS, R.Br. Rare on the basalt, but very common on the moist sides of sandstone hills. August and September.

LABIATÆ.

MENTHA SATUREJOIDES, R.Br. Common on Putty Hill. December to May.

Subclass iii. MONOCHLAMYDEÆ.

PROTEACEÆ.

HAKEA DACTYLOIDES, Cav. Very rare on the Basalt Masses, but very common on the sandstone. In fruit in May. I have not observed so far any other Protead on the Clears or Basalt Masses, though many appear on the sandstone.

THYMELEÆ.

PIMELIA LINIFOLIA, Sm. Rare on the Clears, though common on the sandstone. This species appears to be in flower nearly all the year round.

CASUARINEÆ.

CASUARINA SUBEROSA, Ott. & Dietr. This is not the only species of Casuarina on the Clears and Basalt Masses, but it is the only one collected at present.

SANTALACEÆ.

EXOCARPUS STRICTA, R. Br. Rare on the basalt; common on the sandstone.

Class ii. MONOCOTYLEDONS.

ORCHIDEÆ.

DIPODIUM PUNCTATUM, R.Br. Rare on the basalt. August to October.

DIURIS PEDUNCULATA, R.Br. Very common on the Clears and sandstone country in spring.

PTEROSTYLIS CONCINNA, R.Br. On both formations. May.

CALADENIA CARNEA, R.Br. Very common on both sandstone and basalt formations. July and August.

AMARYLLIDEÆ.

HYPOXIS HYGROMETRICA, Labill. Very common on the Clears. April and May.

LILIACEÆ.

SMILAX GLYCYPHYLLA, Sm. Not as common on the basalt as on the sandstone.

THYSANOTUS JUNCEUS, R.Br. October to December.

SOWERBÆA JUNCEA, Sm. Rare. May.

COMMELYNACEÆ.

COMMELYNA CYANEA, R.Br. Not as common on the Clears as on the sandstone country.

GRAMINEÆ.

Anthistiria australis, R.Br. Locally called "Kangaroo-grass." It resists the frost in a wonderful manner. I have seen specimens of it with stems over 6 feet high.

Class iii. ACOTYLEDONS.

FILICES.

Davallia dubia, R.Br. Rare on the Clears, but plentiful in moist places on the sandstone.

Adiantum æthiopicum, Linn. Common on both formations.

Pteris aquilina, Linn. On Condon Clear.

Blechnum cartilagineum, Swartz. Not common on the basalt, but very common on the sandstone.

Asplenium flabellifolium, Cav. In shady and moist places on the Clears.

Mr. Maiden exhibited (1) clusters of fruits of *Eucalyptus longifolia*, Link and Otto, from near Gosford, N.S.W., with as many as seven in the umbel, whereas it has hitherto been understood that this species has characteristically three flowers in the umbel, or occasionally four. (2) A specimen of the Calvary Clover (*Medicago intertexta*, Linn.), from South Europe, a species with an especially large burr (as large as a cherry), which promises to be a pest to wool-growers; it has made its appearance at Manildra, N.S.W. And (3) a letter from Sir Joseph Banks, dated December 7th, 1797, to Dr. Arne of Liverpool, chiefly on galvanism. Also a portrait of Sir Joseph from the European Magazine of 1802. This portrait appears to be comparatively rare.

Mr. G. A. Waterhouse drew attention to the migration of butterflies (*Belenois java*, Sparrman), occurring that day, noticed also as far inland as Leura on the Blue Mts. The butterflies were travelling from south to north.

Mr. Fletcher exhibited a collection of fresh botanical specimens forwarded by Mrs. Forde, representing about twenty-fine species of native plants just now flowering in the neighbourhood of Pambula.

Mr. Stead exhibited specimens of a remarkable barnacle (*Coronula diadema*, Linn.) attached to portion of the skin of a whale, and also a number of another crustacean (*Cyamus ceti*, Linn.), one of the so-called "whale-lice" procured at the same time; and he contributed the following Note thereon:—

"The barnacles exhibited were collected by Captain W. Waller off Cavalli Island, on the coast of New Zealand, in lat. 35° 00′ S. and long. 174° 5′ E. The whale from whose skin they were cut was found lying dead, floating at the surface of the ocean. From the description furnished it would seem to have been a Finback or Rorqual *(Balænoptera)*. There was a patch of barnacles on the breast 4 ft. square, from which the specimens exhibited were secured. There were also several other large patches on the whale's belly, the individuals being of about the same size as those collected. Through the disintegration of the outer walls, the compartments in the barnacle-shells had in many places become exposed, and where these were not fully occupied by the epidermis of the whale, they were completely filled with numbers of the Whale-louse (*Cyamus ceti*, Linn.). These crustaceans were also crowded round the bases of the barnacles and were of all sizes up to about 13 mm. in length. Growing from the summit of the *Coronula* in many instances were numbers of a stalked barnacle—a species of *Conchoderma* (probably *C. aurita*, Linn.).

"Regarding the occurrence of *Coronula diadema* in these seas, Darwin, writing in 1854 (Monog. Cirrip. Balanidæ, p. 419) stated:—'There is also a specimen in the British Museum sent by Mr. Stephenson, mingled with shells of mollusca from New Zealand; but a *Coronula* procured from a whale in the early part of the outward voyage might so easily be sent home with specimens subsequently collected in another county [? country] that I do not as yet fully admit that this species is an inhabitant of the Southern Pacific Ocean.' Under these circumstances, therefore, the new record is of more than ordinary interest.

"*Coronula diadema*, Linn., has been taken from whales in the Arctic Seas, those of the United States and Great Britain, the Gulf Stream, the Atlantic Ocean, and now from New Zealand.

"The Whale-louse, *Cyamus ceti*, Linn., was recorded from these seas for the first time in 1884 by Chilton (Trans. N.Z. Inst. xvi., p. 252) from specimens obtained by von Haast from *Euphysetes potsii*."

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CORRIGENDA.

Page 5, line 29—insert a comma after petiolate.

Page 6, line 43—*for* pine *read* spine.

Page 7, section 26 (25), first line—insert a comma after body.

Page 7, last line but one—*for* above *read* on.

Page 7, last line—substitute a comma for the period, and add the words "equidistant from each other and the eyes."

Page 25, line 20—*for* eye *read* eyes.

Page 26, lines 7 and 11—for *falcatus* read *falcata*.

Page 41, at the bottom, add—All of the Australian *Membracidæ* thus far examined by me belonged to the Subfamily *Centrotinæ*.

Page 59, line 10—for *Damina* read *Danima*.

Page 66, line 19—for *Discopheblia catocalina* read *Discophlebia catocalina*.

Page 94, line 14—for *Exoascus bullacus* read *Exoascus bullatus*.

Page 119, line 35—*for* 67·08 *read* 64·68.

Page 314, line 3—for *Ogyris idino* read *Ogyris idmo*.

Page 323, line 2—for *Spondylaspis hirsutus* read *Spondyliaspis hirsuta*.

Page 324, line 12—for *Spondylaspis nigro-cincta* read *Spondyliaspis nigro-cincta*.

Page 348, line 6—*for* gelatine *read* galactan.

Page 352, line 17—for *E. Gunni* read *E. Gunnii*.

Page 363, line 19—for *Busaria spinosa* read *Bursaria spinosa*.

Page 412, line 31—for *Pentratropis* read *Pentatropis*.

Page 414, line 11—for *Protaceæ* read *Proteaceæ*.

Page 585, lines 4 and 25—for *Rhæbolestus* read *Rhæbolestes*.

Page 606, line 19—for *N. queenslandica* read *N. queenslandicus*.

Page 615, line 13—*for* ridgid *read* rigid.

Page 615, line 34—for *Homalosoma cyaneocincta* read *Homalosoma cyaneocinctum*.

Page 635, line 27—for *P. rufilabris* read *T. rufilabris*.

Page 685, line 10—for *mundus* read *munda*.

Page 688, line 26—for *furruginascens* read *ferruginascens*.

Page 706, line 3—for *S. australe* read *A. australe*.

Page 707, line 4—for *Graphalium* read *Gnaphalium*.

Page 715, line 15—for *Xanthoxylon* read *Xanthoxylum*.

Page 724, line 31—for *Isolepsis* read *Isolepis*.

Page 733, line 11—for *B. attenuata* and *B. lanceolata* read *B. attenuatum* and *B. lanceolatum*.

Page 742, lines 20 and 21—for *Neuropogon melaxantha* read *Neuropogon melaxanthus*.

Page 785, line 2—for *Solanum Baueriana* read *Solanum Bauerianum*.

Page 920, lines 21, 22, 29—for *J. latifolia* and *J. angustifolia* read *T. latifolia* and *T. angustifolia*.

In the legend of fig. 9 of Plate xxvii.—*for* NAMULOWA *read* NAMULOWAI.

In Plate xxxiii. (Geological Sketch Map of Part of Viti Levu, Fiji)—

For Yanuka *read* Yanuca.

For Naruaru *read* Naruarua.

For Nadakum *read* Nadakuni.

For Navurimolau *read* Navunimolau.

The name of the Sigatoka River, flowing into the sea at Conua, unfortunately has been omitted.

In Plate xxxiv. (Generalised Geological Section across Viti Levu)—

For Nasoga *read* Nasoqo.

For Wai ni Mata *read* Wainimala.

The legend "W. scarp of high mountains, Nabui, &c.," should be half an inch to the left of its position as marked.

All the Rocks to the south of "Navua R., S. of Qarawai," which in the Section are shown as Basaltic Series, should have been shown as Andesitic Series.

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Ecnomodes (Lepidopt.)	69	*Pheressaces* (Lepidopt.)	56
Epidictica (Lepidopt.)	81	*Phersita* (Coleopt.)	591
Epopsia (Lepidopt.)	89	*Porcorhinus* (Homopt.)	38
Eufrenchia (Homopt.)	24	*Queenslandica* (Coleopt.)	664
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Geijerolyma (Homopt.)	335	*Teleclita* (Lepidopt.)	53
Hedycharis (Lepidopt.)	90	*Tepperia* (Coleopt.)	660
Henmania (Liliaceæ)	105	*Themerastis* (Lepidopt.)	68
Lubra (Homopt.)	28		

[Printed off April 23rd, 1904.]

F. Cunninghame & Co., Printers, 146 Pitt Street, Sydney.

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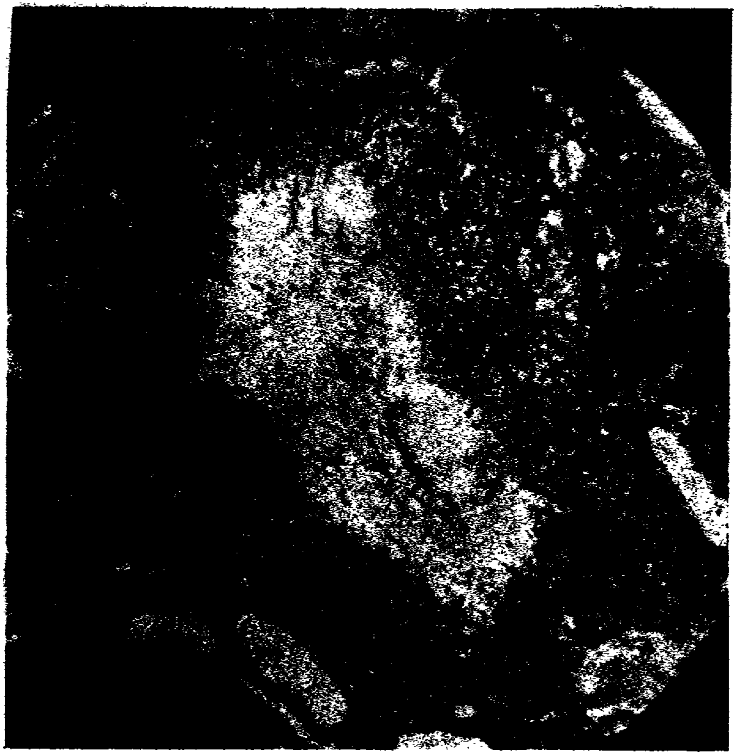

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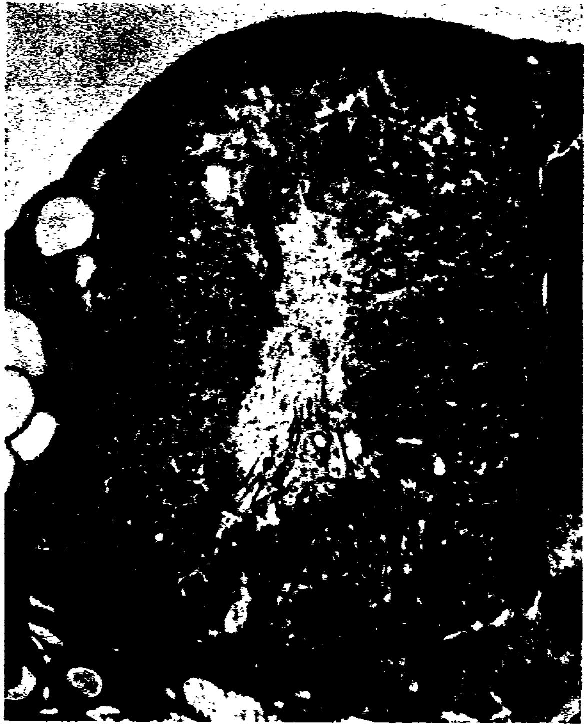
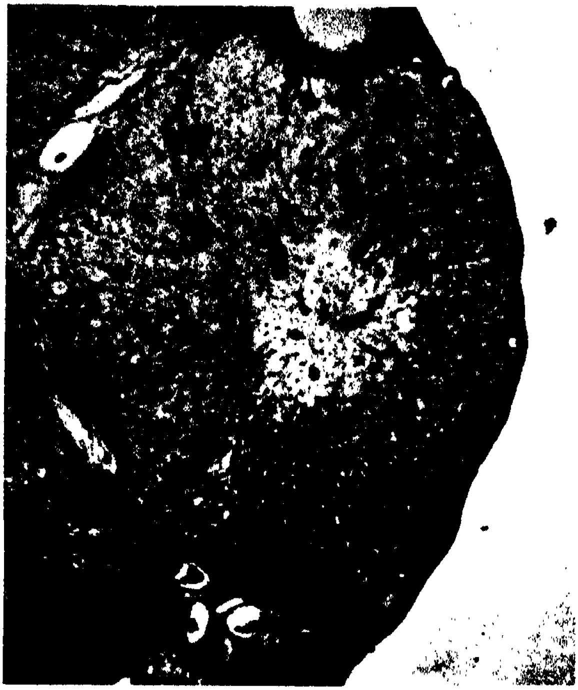


Fig. 13.

CORPUS LUTEUM OF DASYURUS.



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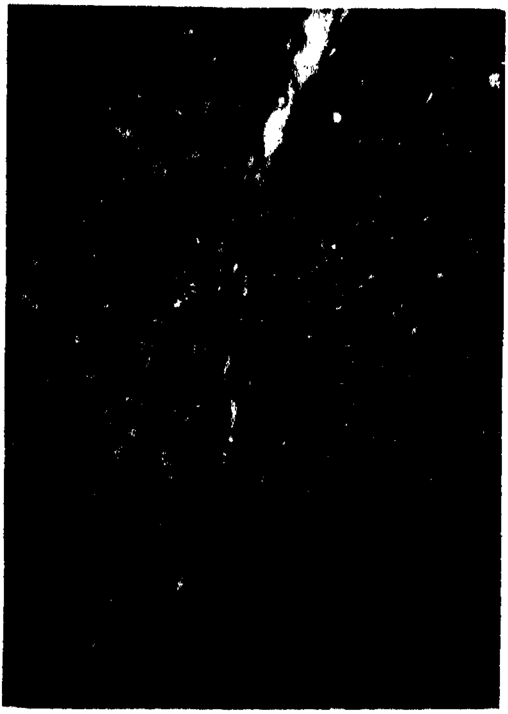

Fig. 15.

CORPUS LUTEUM OF DASYURUS.

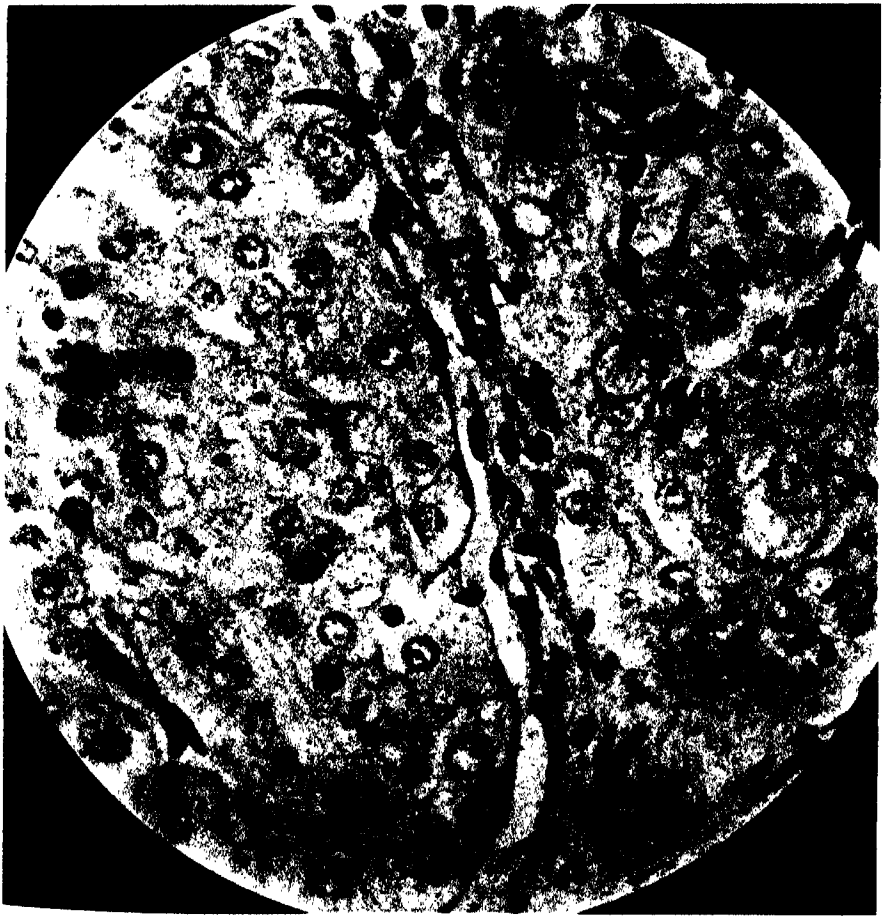

Fig. 16.

CORPUS LUTEUM OF DASYURUS.

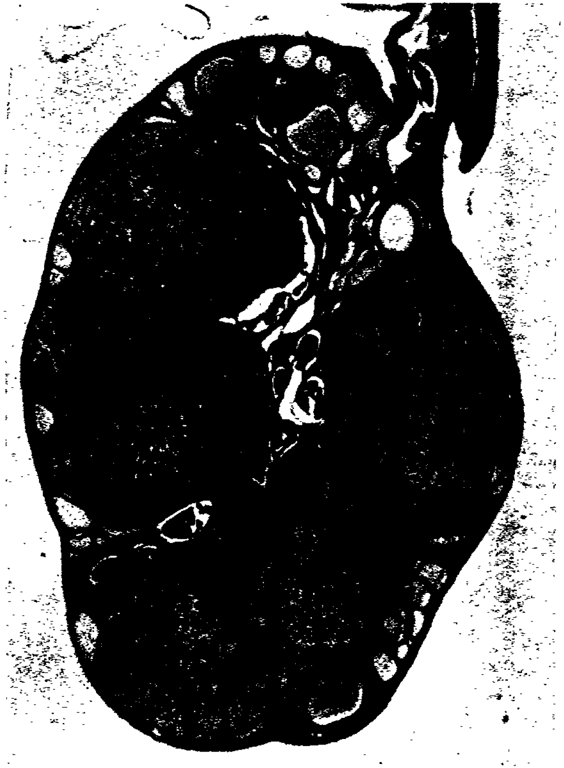

Fig. 17.

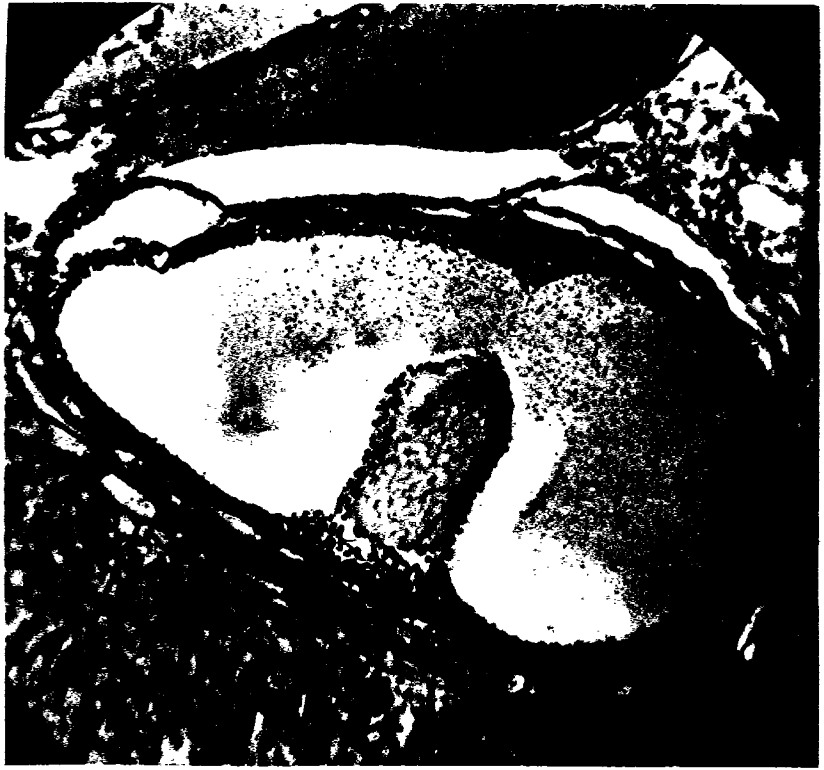

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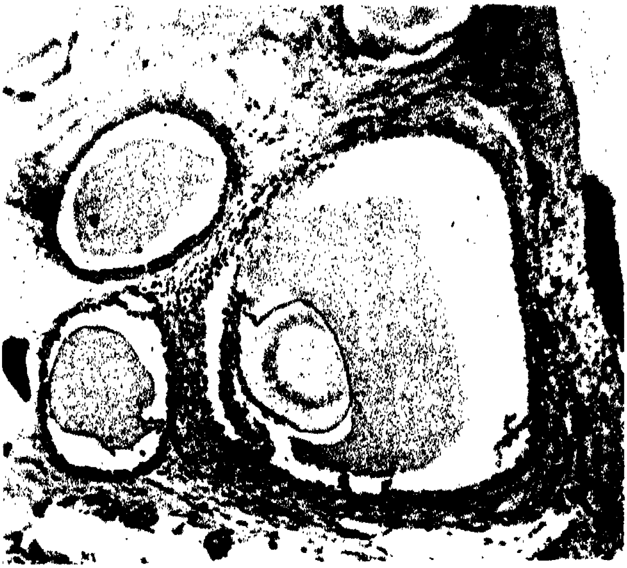
Fig. 18.



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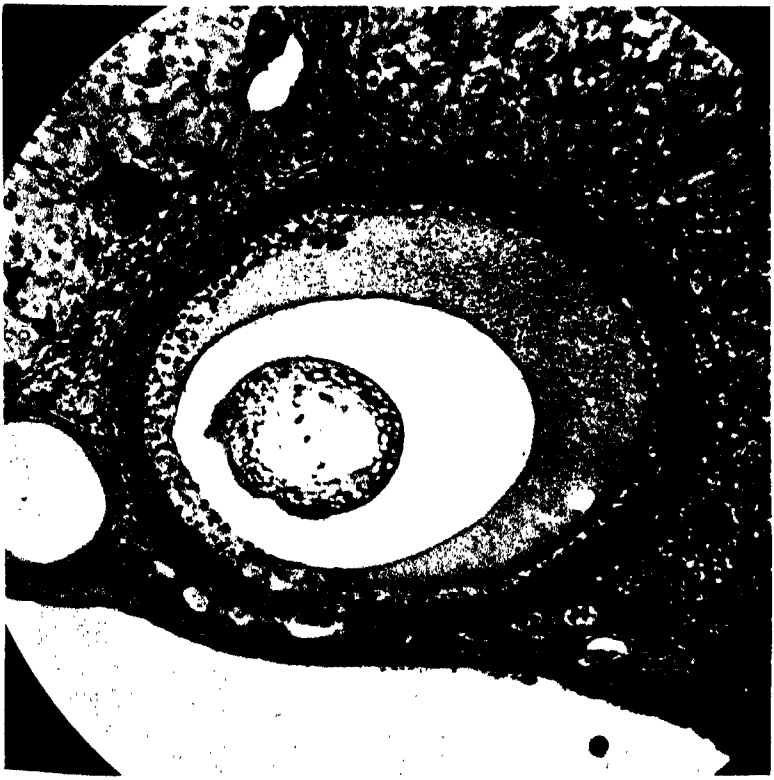


Fig. 20.

CORPUS LUTEUM OF DASYURUS.

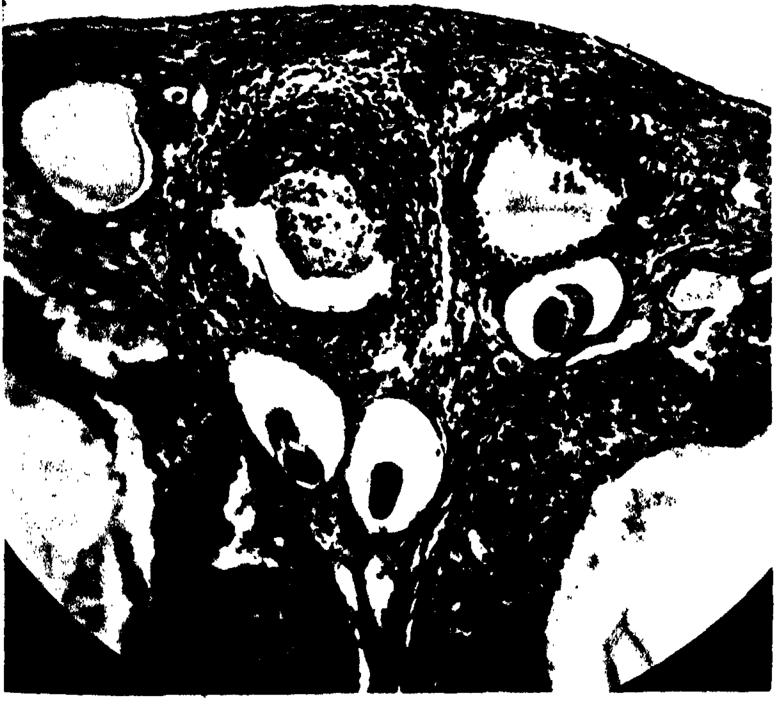


Fig. 21.

CORPUS LUTEUM OF DASYURUS.

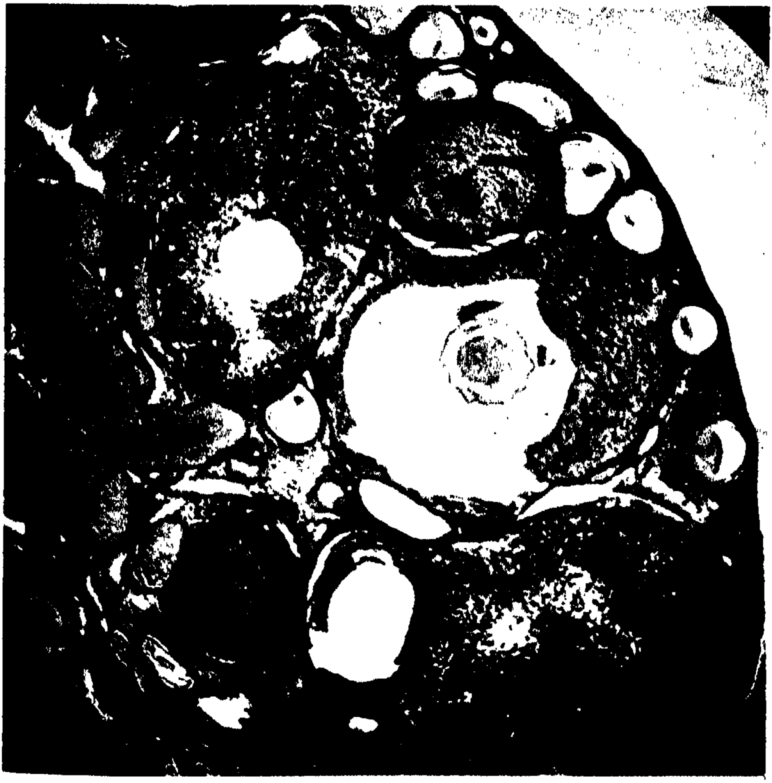


Fig. 22.

CORPUS LUTEUM OF DASYURUS

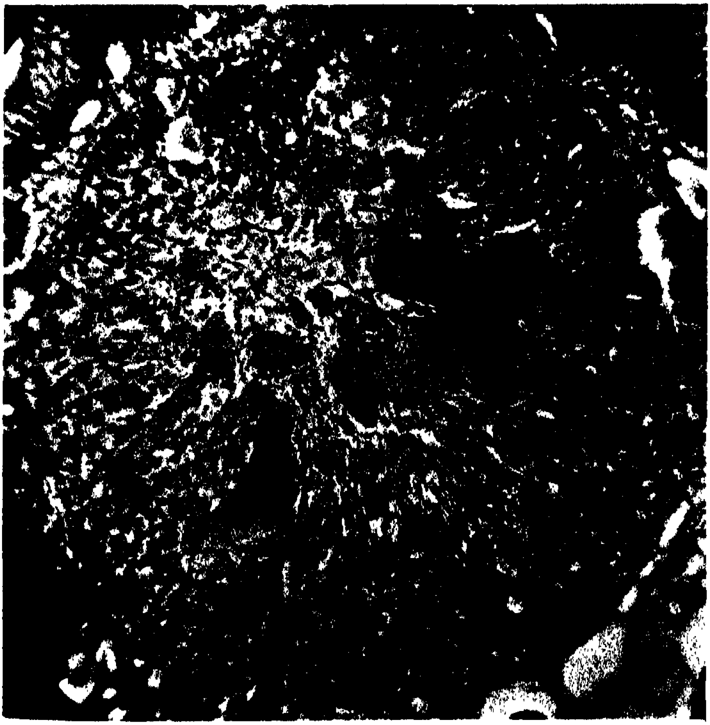


Fig. 23.

CORPUS LUTEUM OF DASYURUS.

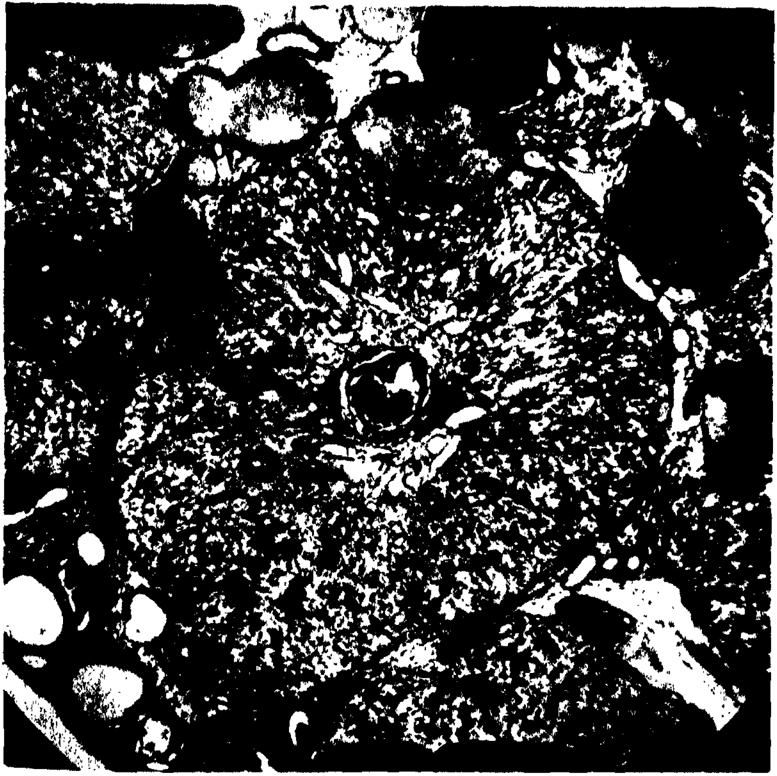
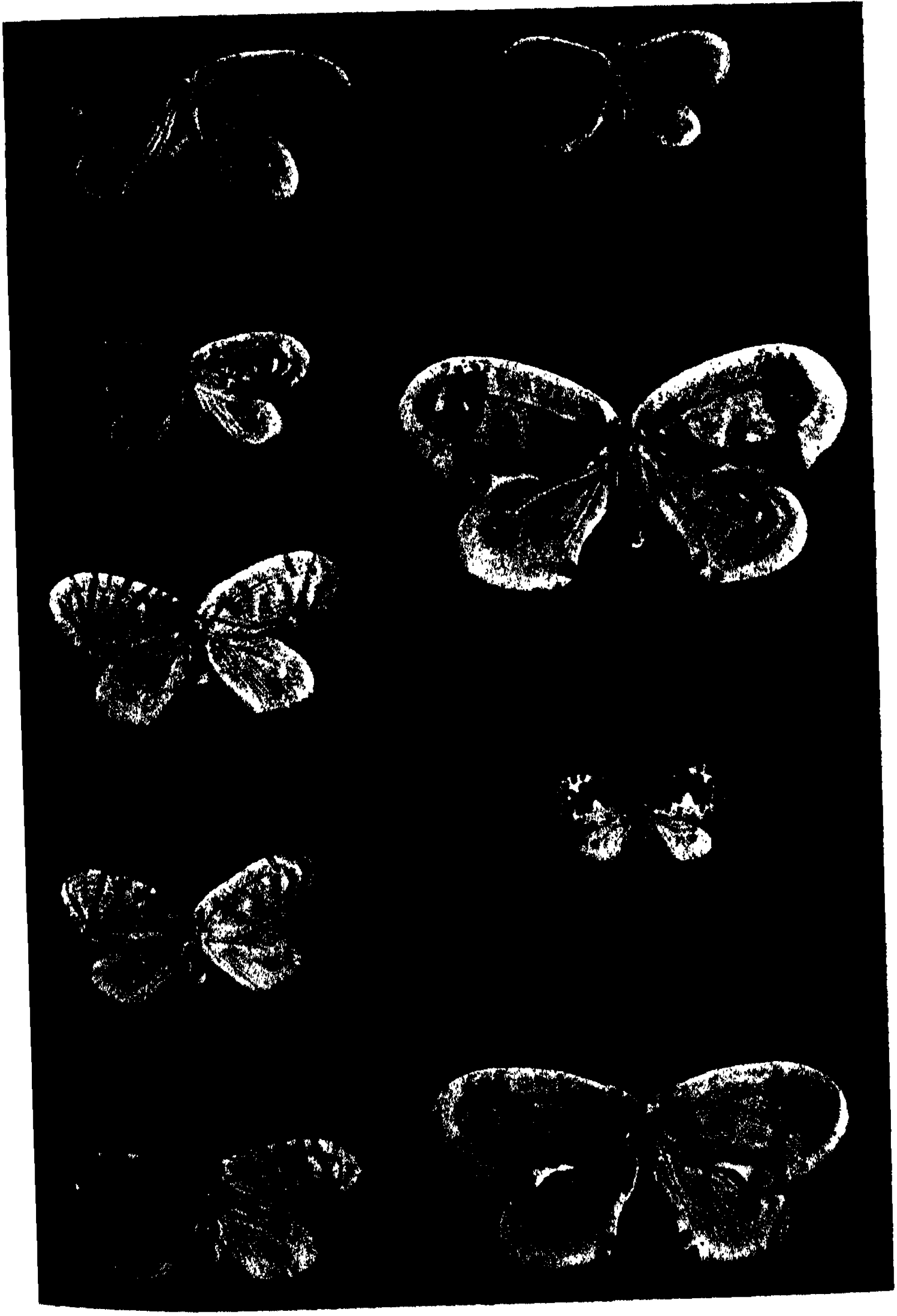


Fig. 24.

CORPUS LUTEUM OF DASYURUS



GENUS PSYCHOPSIS (NEUROPTERA).

Fig. 1.

[illegible] BY [illegible] WALU BAY

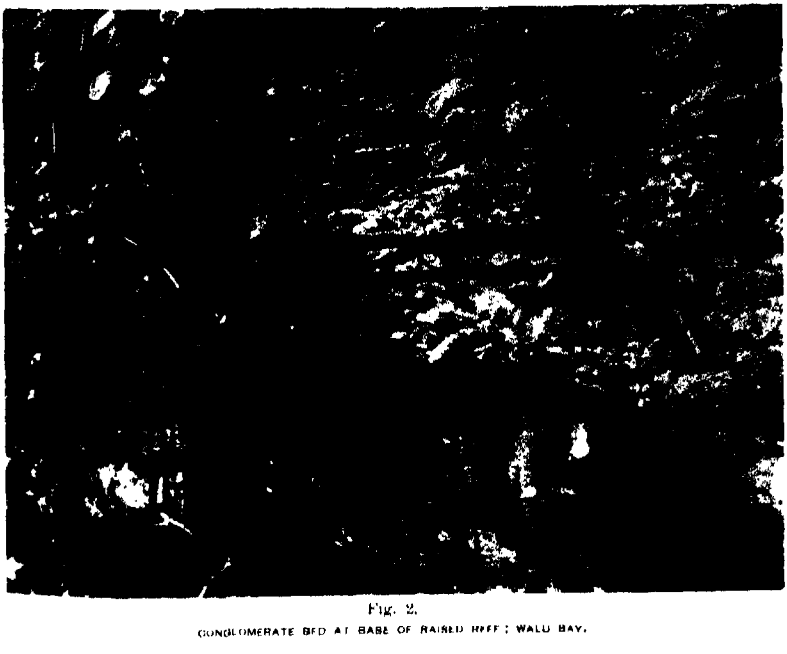


Fig. 2.

CONGLOMERATE BED AT BASE OF RAISED REEF; WALU BAY.

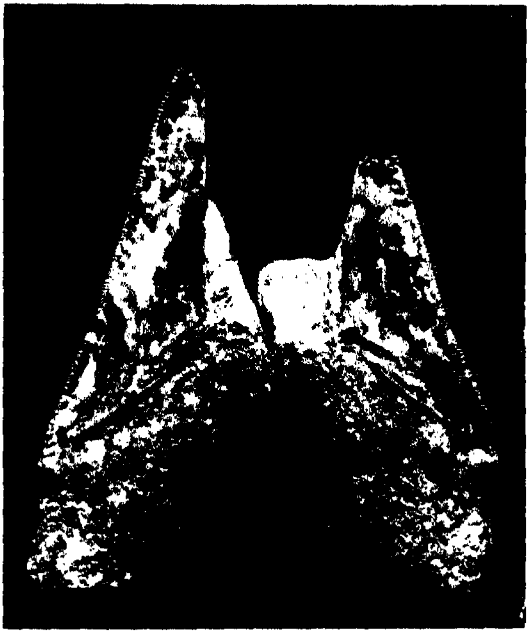


Fig. 3.

CARCHARODON TOOTH FROM RAISED REEF.

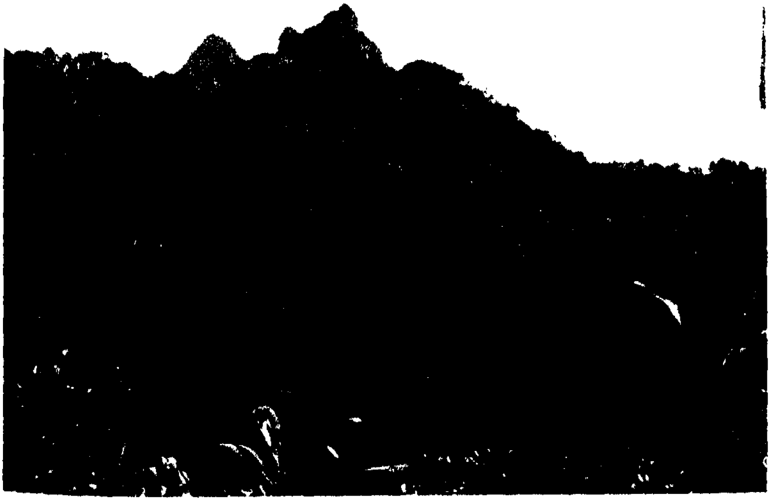


Fig. 4.

THE GREAT DYKE OF DEVO.

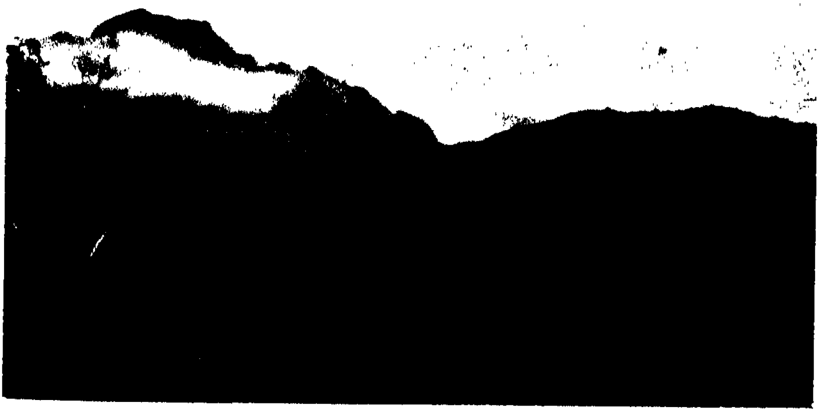


Fig. 5.

BUKI LEVU, FROM THE SOUTH.

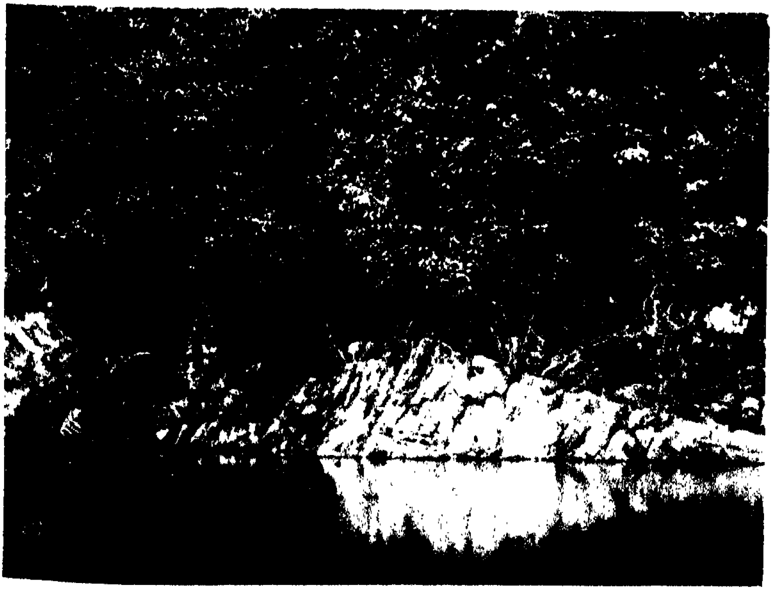


Fig. 6.

JOINTED TUFFS : WAILOA RIVER

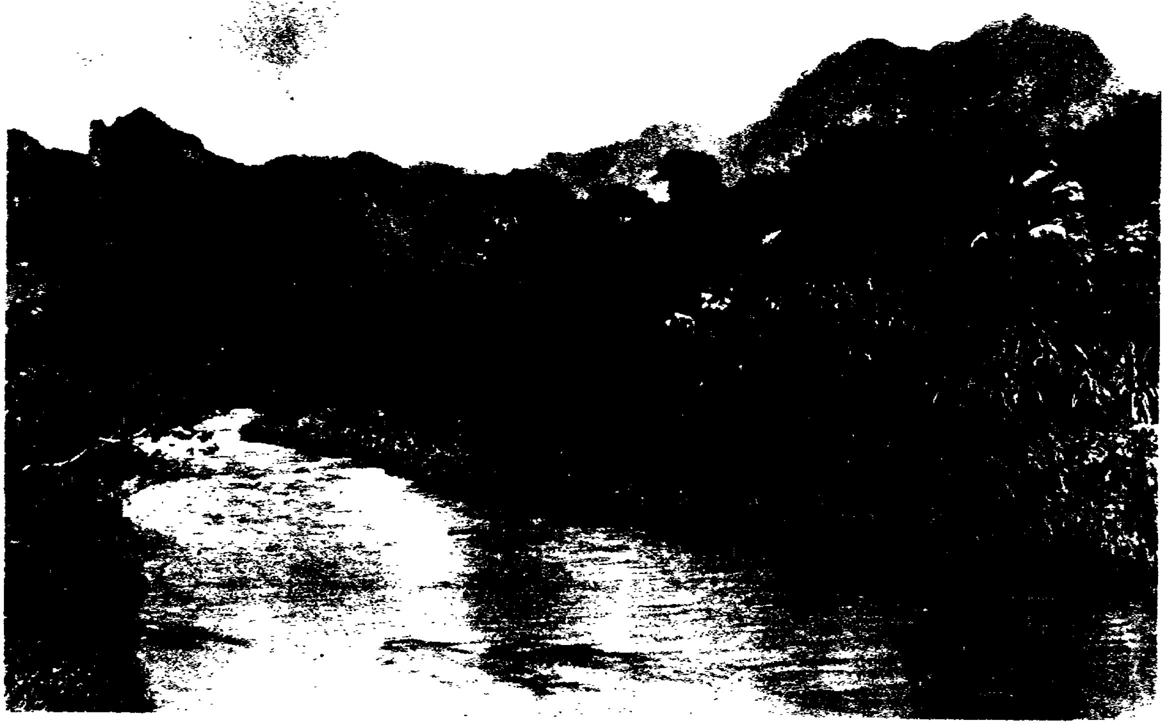


Fig. 7 (with Fig. 8).

PANORAMIC VIEW OF RANGE OF VOLCANIC MOUNTAINS ON UPPER WAIGINA

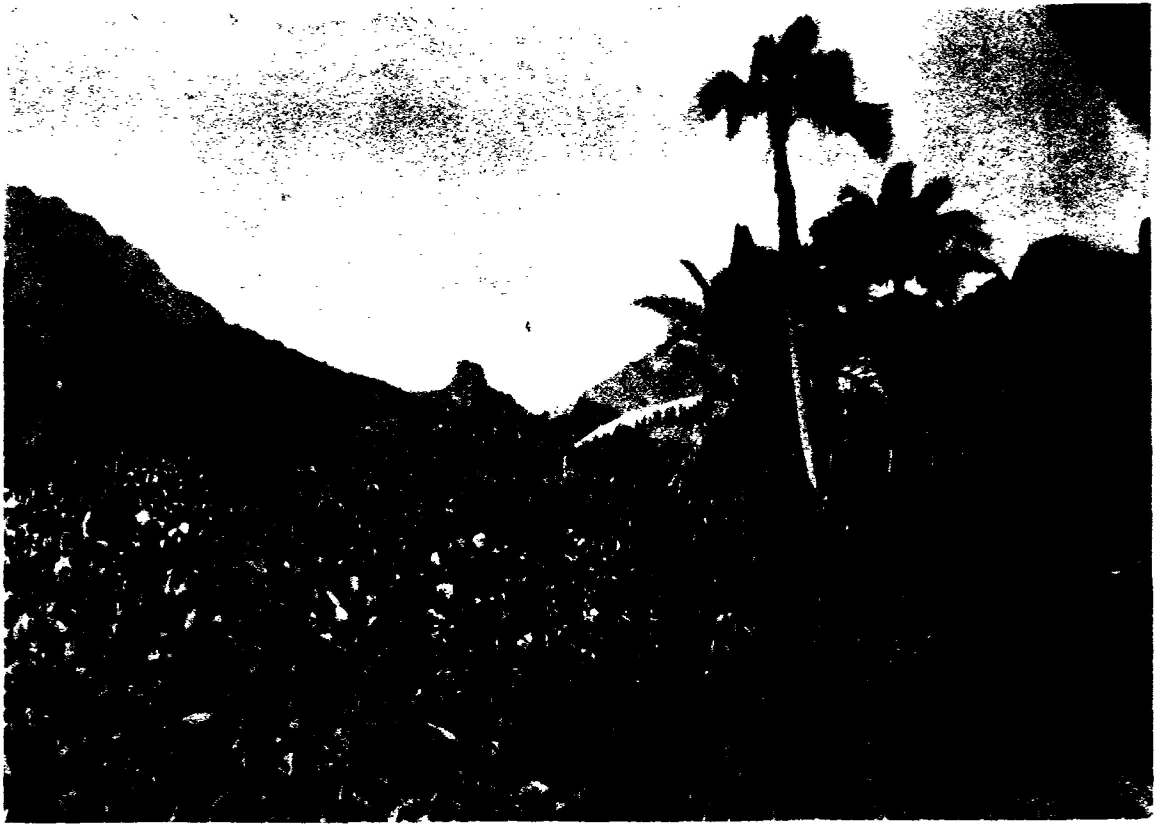


Fig. 8 (with Fig. 7)

PANORAMIC VIEW OF RANGE OF VOLCANIC MOUNTAINS ON UPPER WAIDINA.

Fig. 9.

NAMULOWA.

Fig. 10.

NABUI.

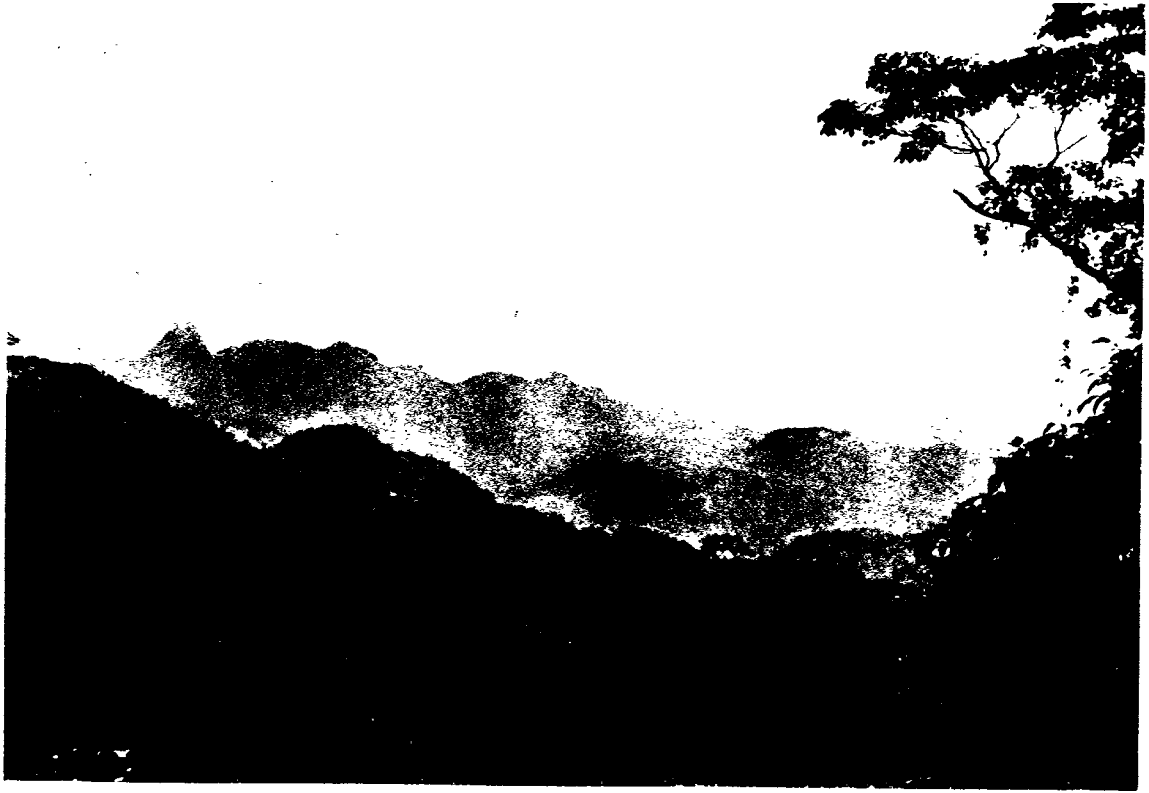


Fig. 11.

KOROBASABASAGA FROM THE PASS OF NAVUNITORILAU.

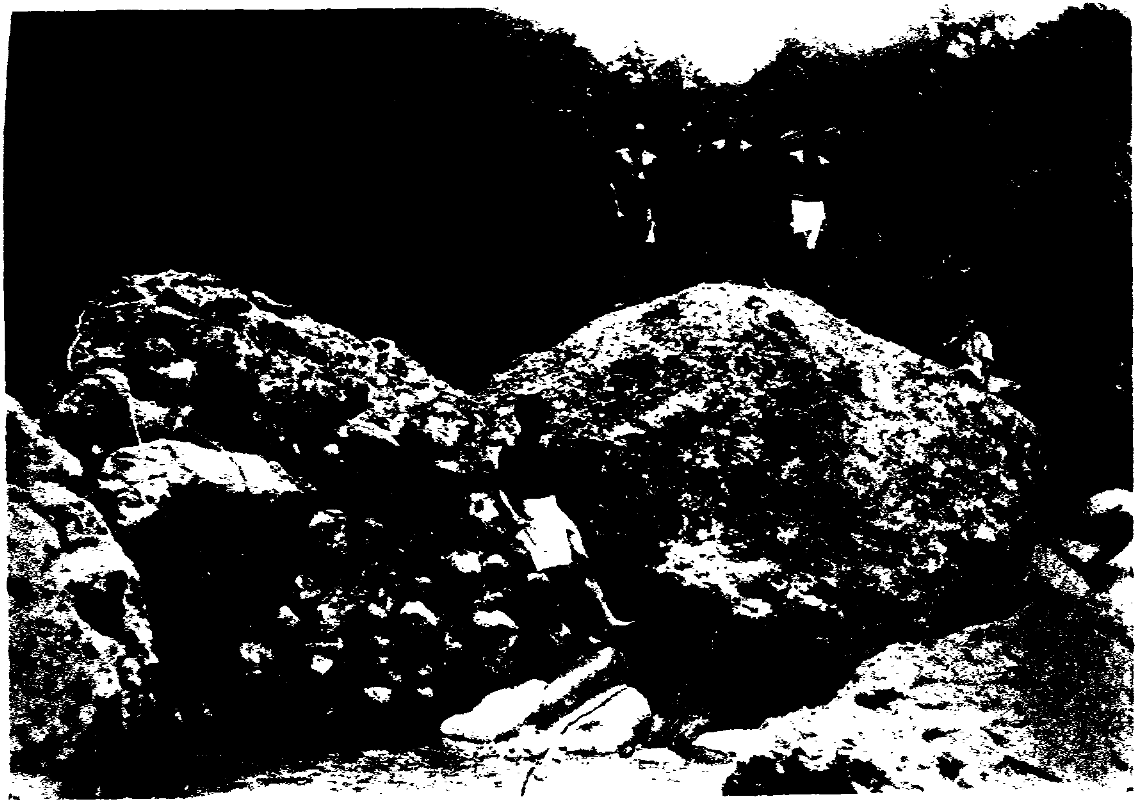


Fig. 12.

BOULDERS OF COARSE VOLCANIC AGGLOMERATE, NAVUA RIVER.

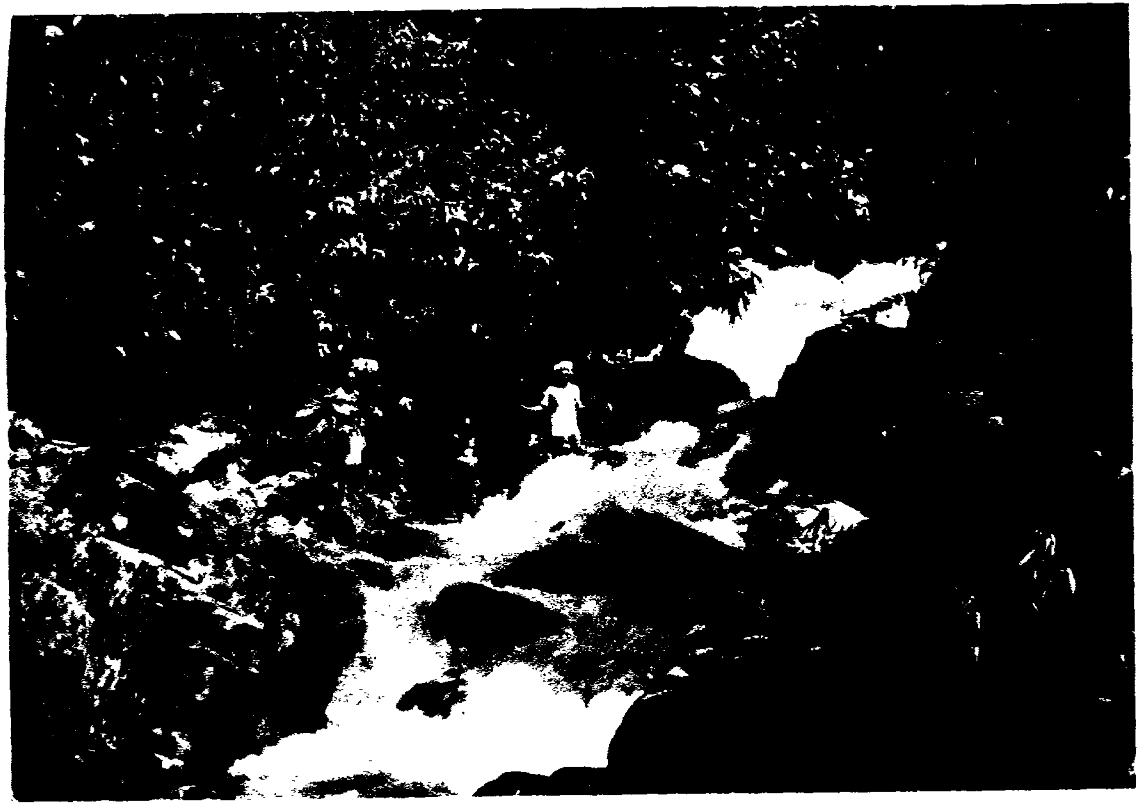


Fig. 13

QUARTZ DIORITE *in situ*; HEAD OF WAINBUA RIVER

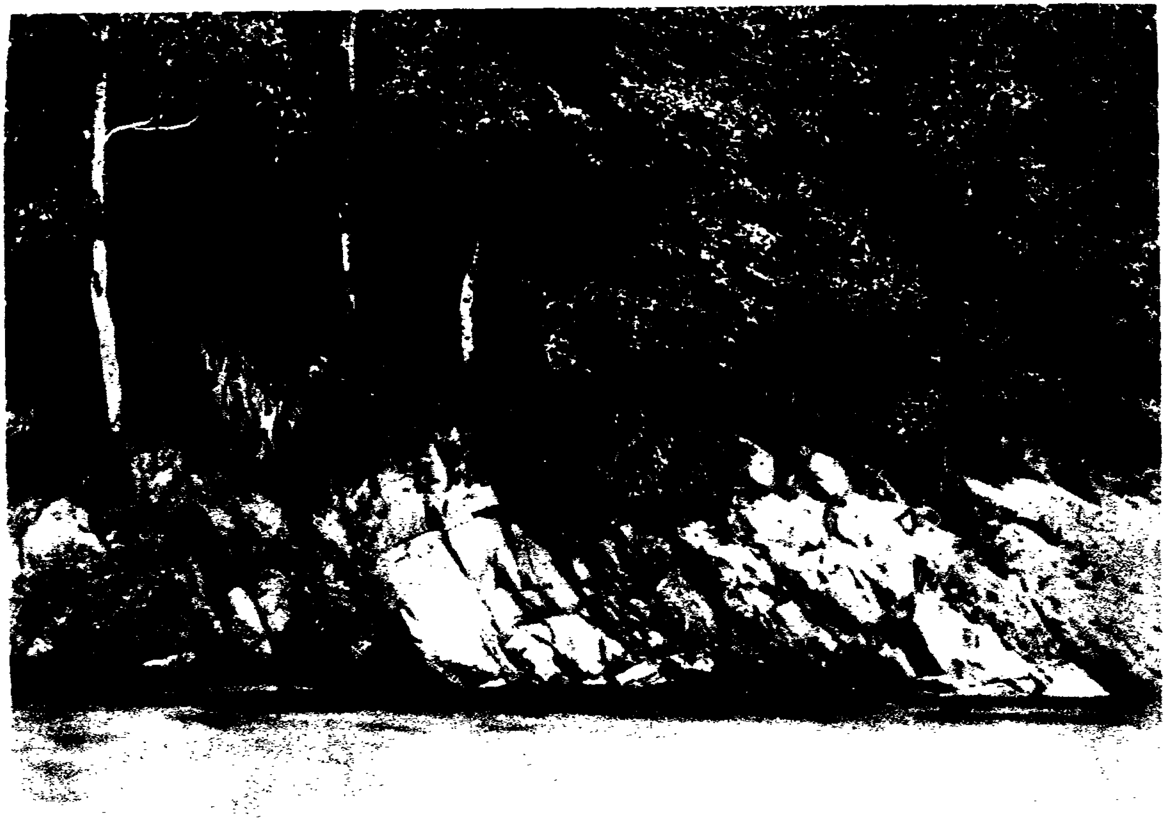


Fig. 14.

QUARTZITES AND SLATES: WAINIMALA RIVER.

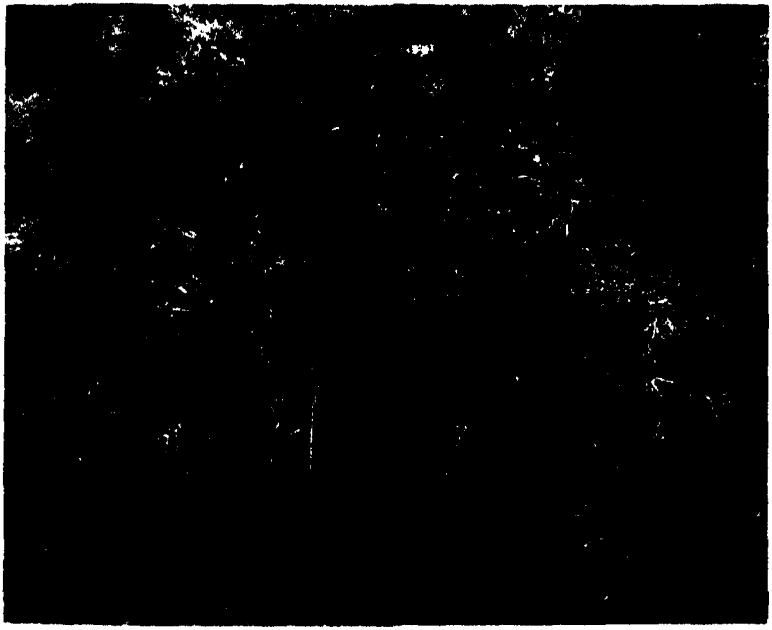


Fig. 15.

PRISMATIC ANDESITE ; DRAU.

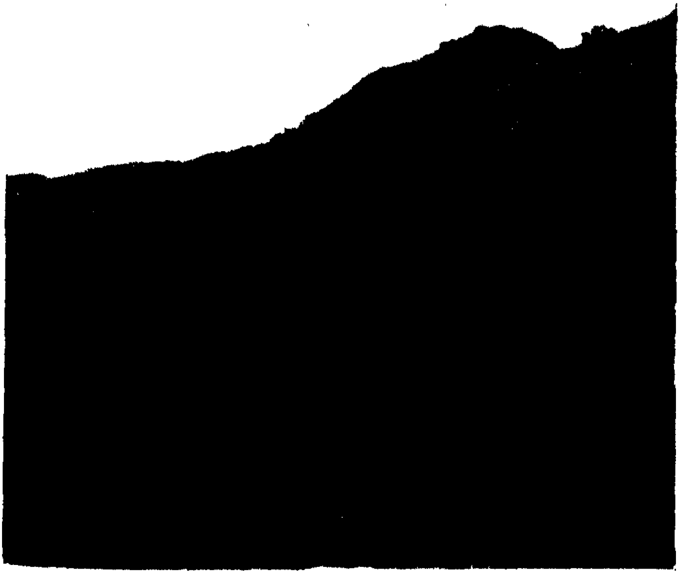


Fig. 16.

LEVEL-BEDDED MARINE TUFFS ; BUA LEVU.

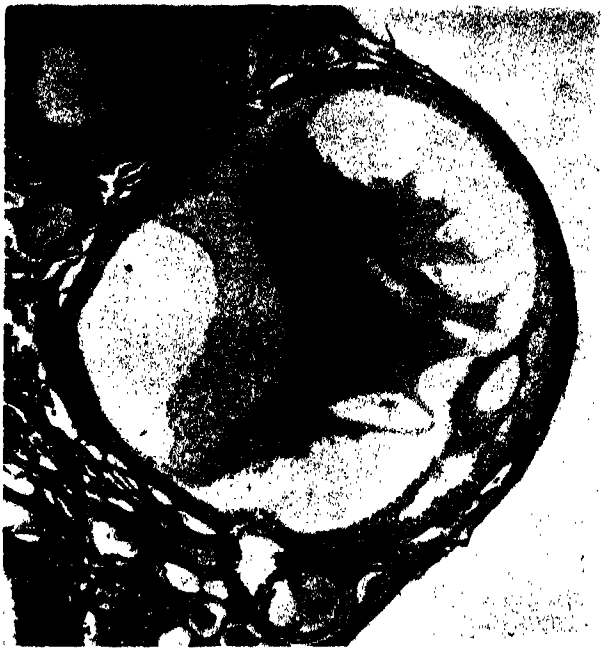


Fig. 5.

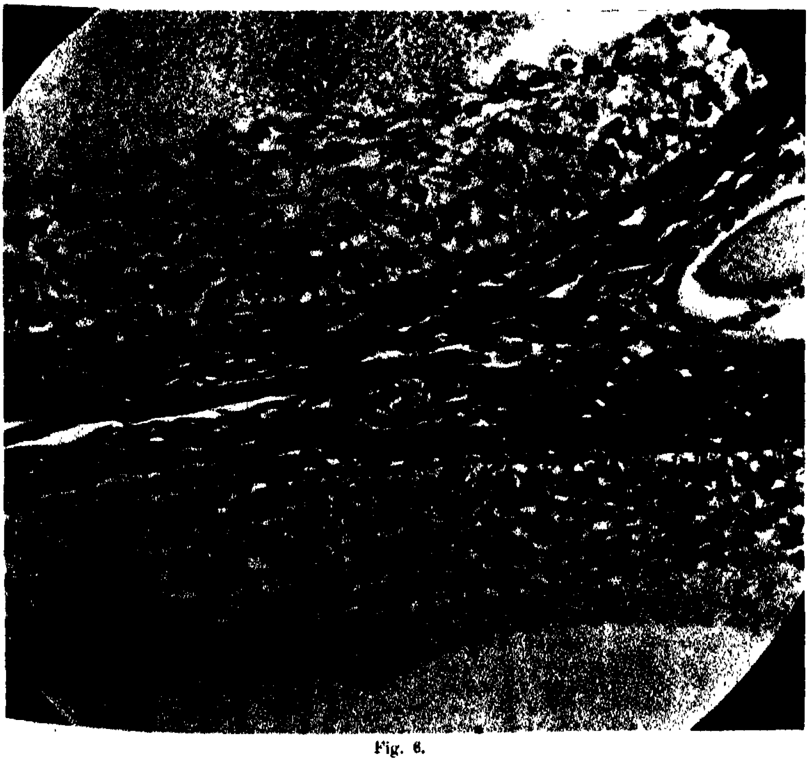


Fig. 6.

CORPUS LUTEUM OF DASYURUS.

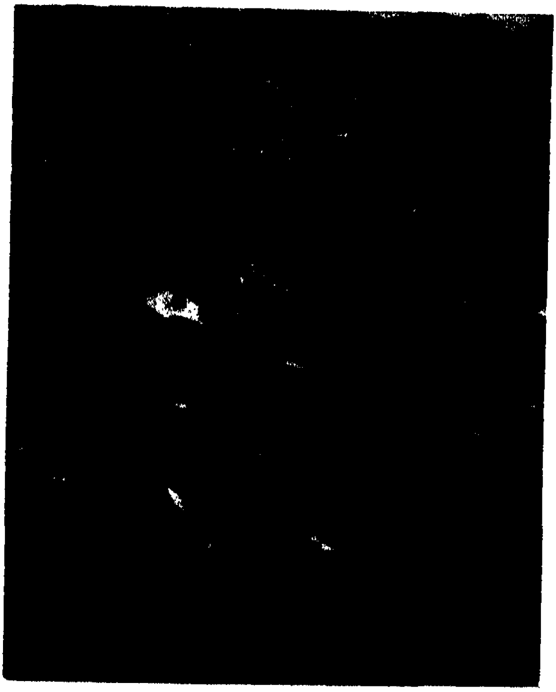


Fig. 7.

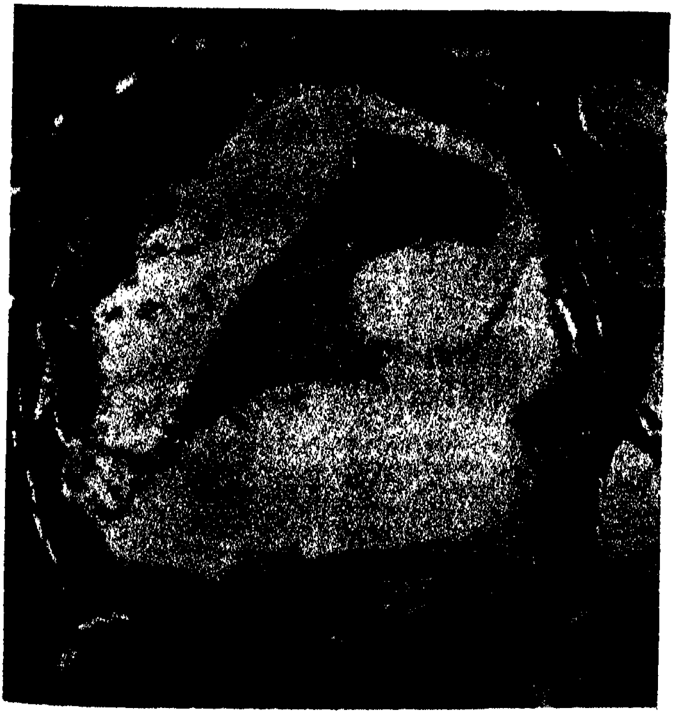


Fig. 8.

CORPUS LUTEUM OF DASYURUS.

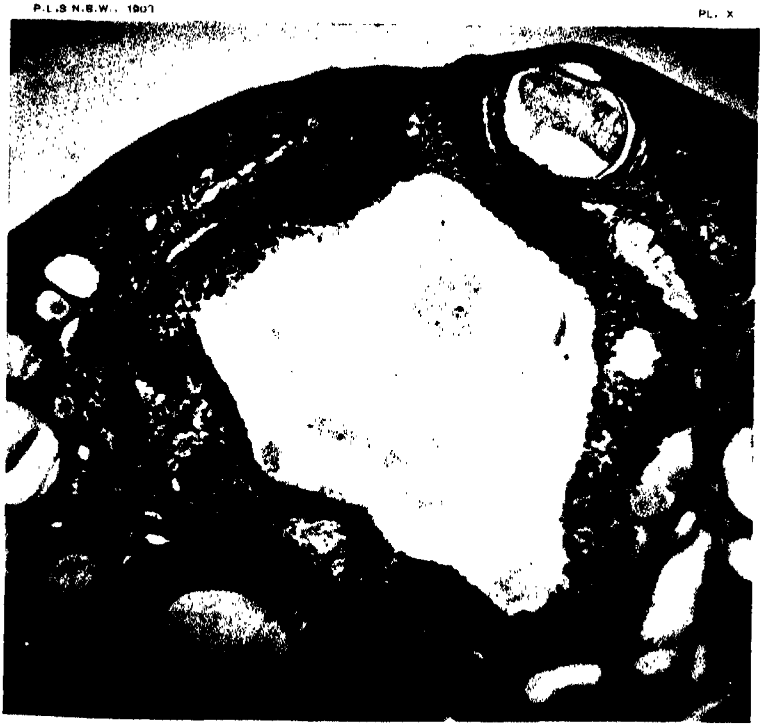


Fig. 9

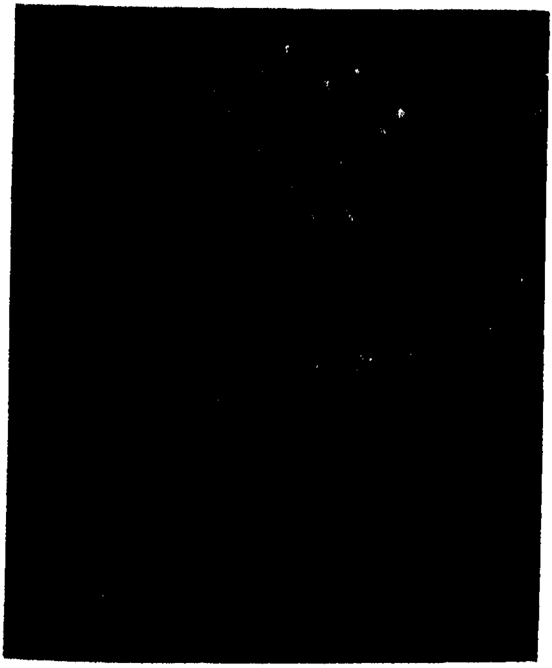
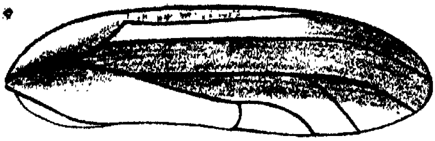


Fig. 10.

CORPUS LUTEUM OF DASYURUS.



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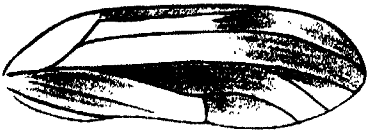

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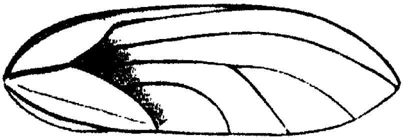

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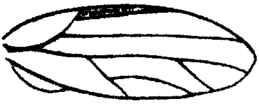

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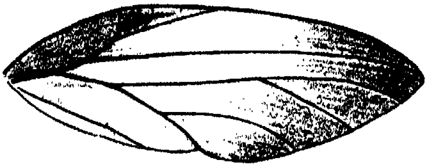

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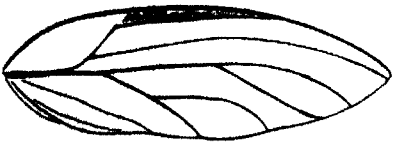

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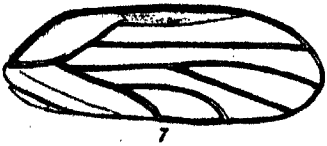

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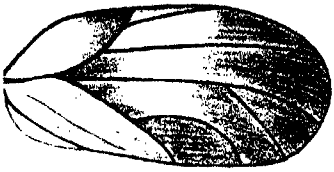

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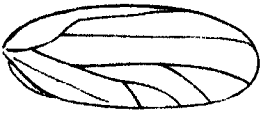

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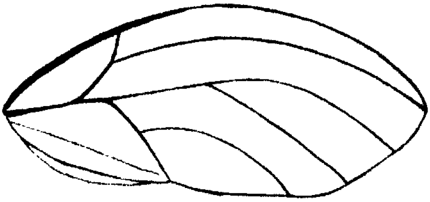

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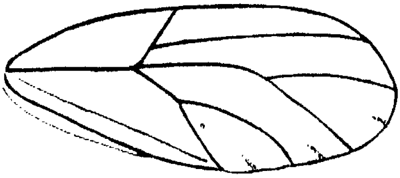

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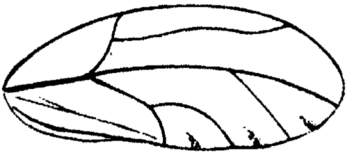

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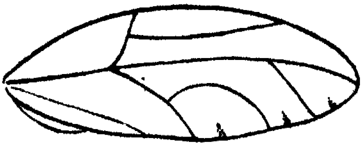
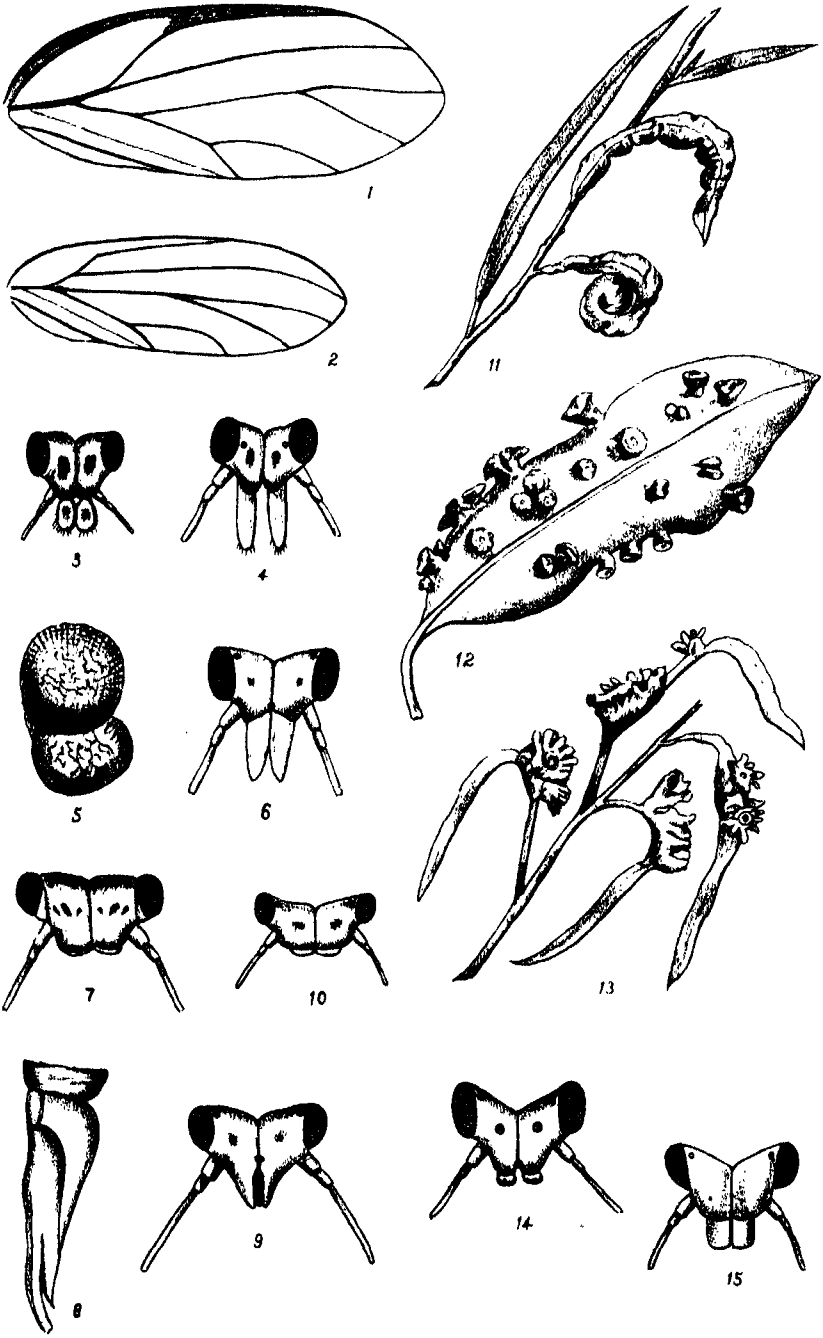


13

W.W.F. del.

AUSTRALIAN PSYLLIDAE.



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AUSTRALIAN PSYLLIDAE.

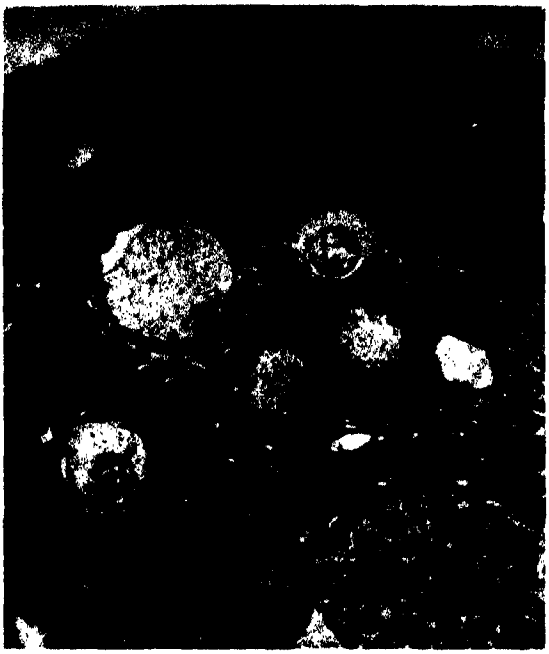


Fig. 1.

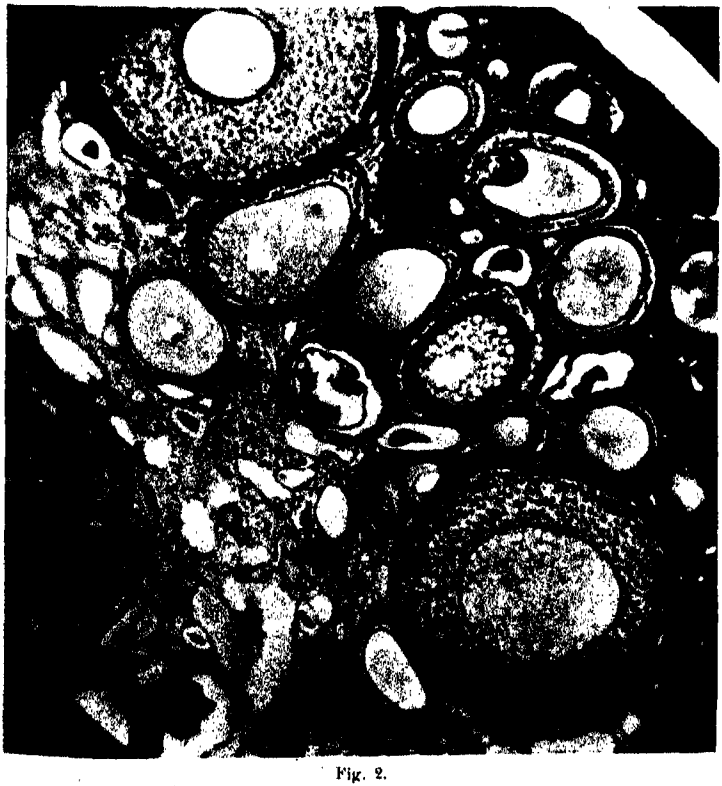


Fig. 2.

CORPUS LUTEUM OF DASYURUS.

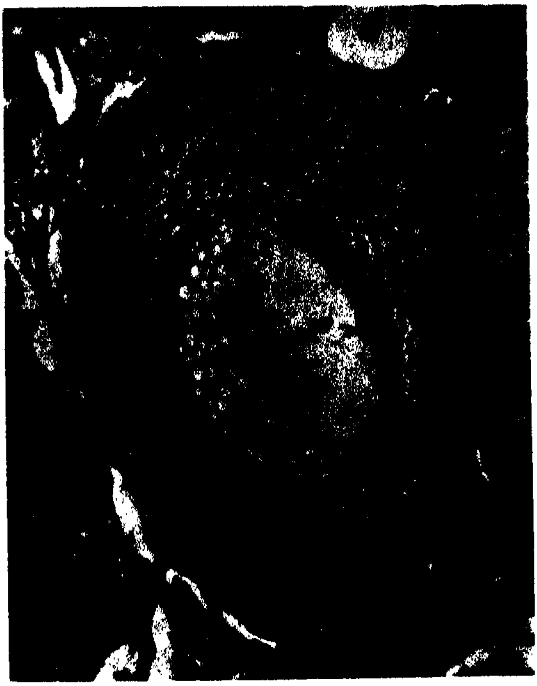


Fig. 3.

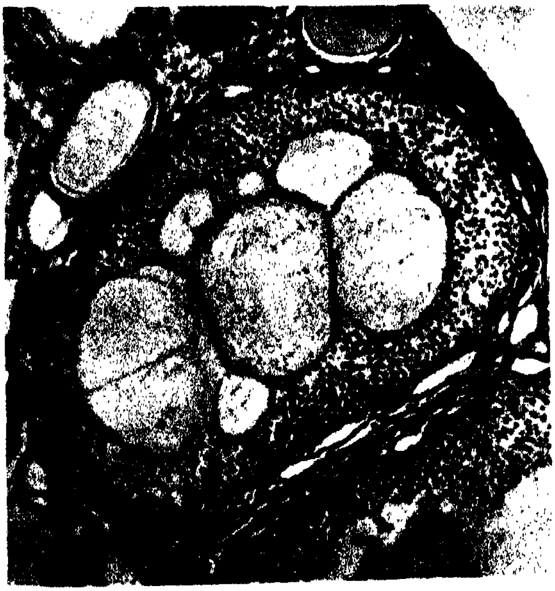
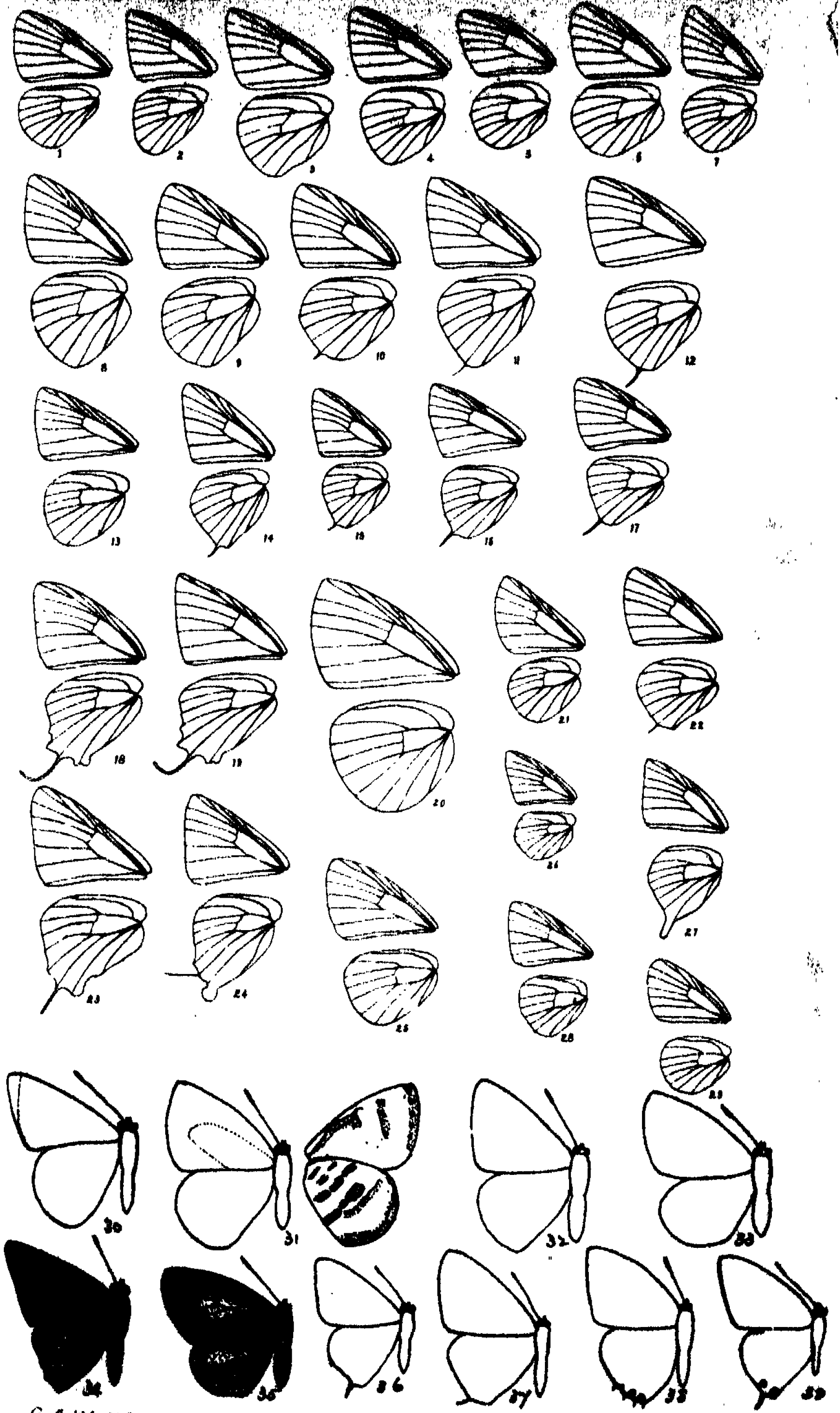


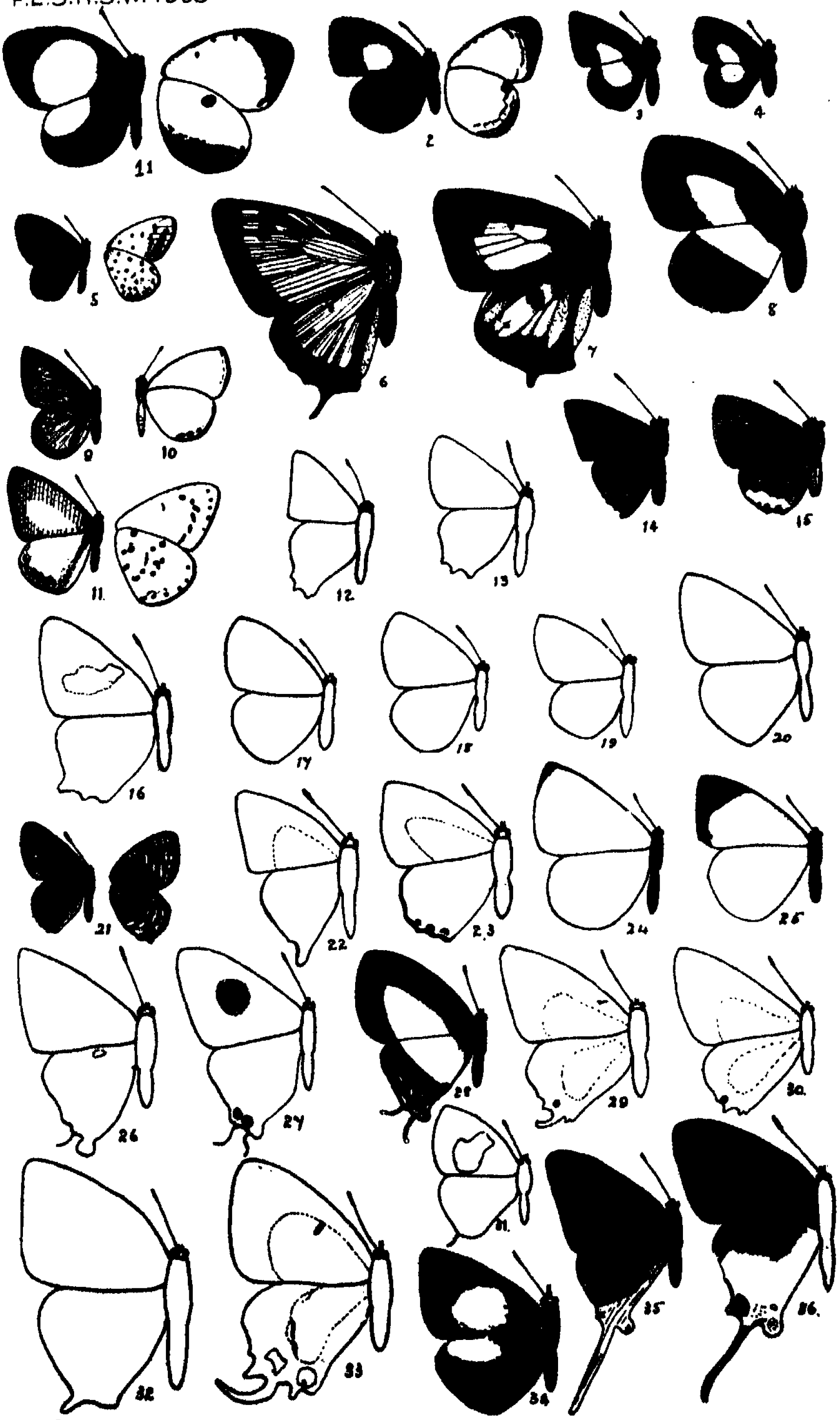
Fig. 4.

CORPUS LUTEUM OF DASYURUS.



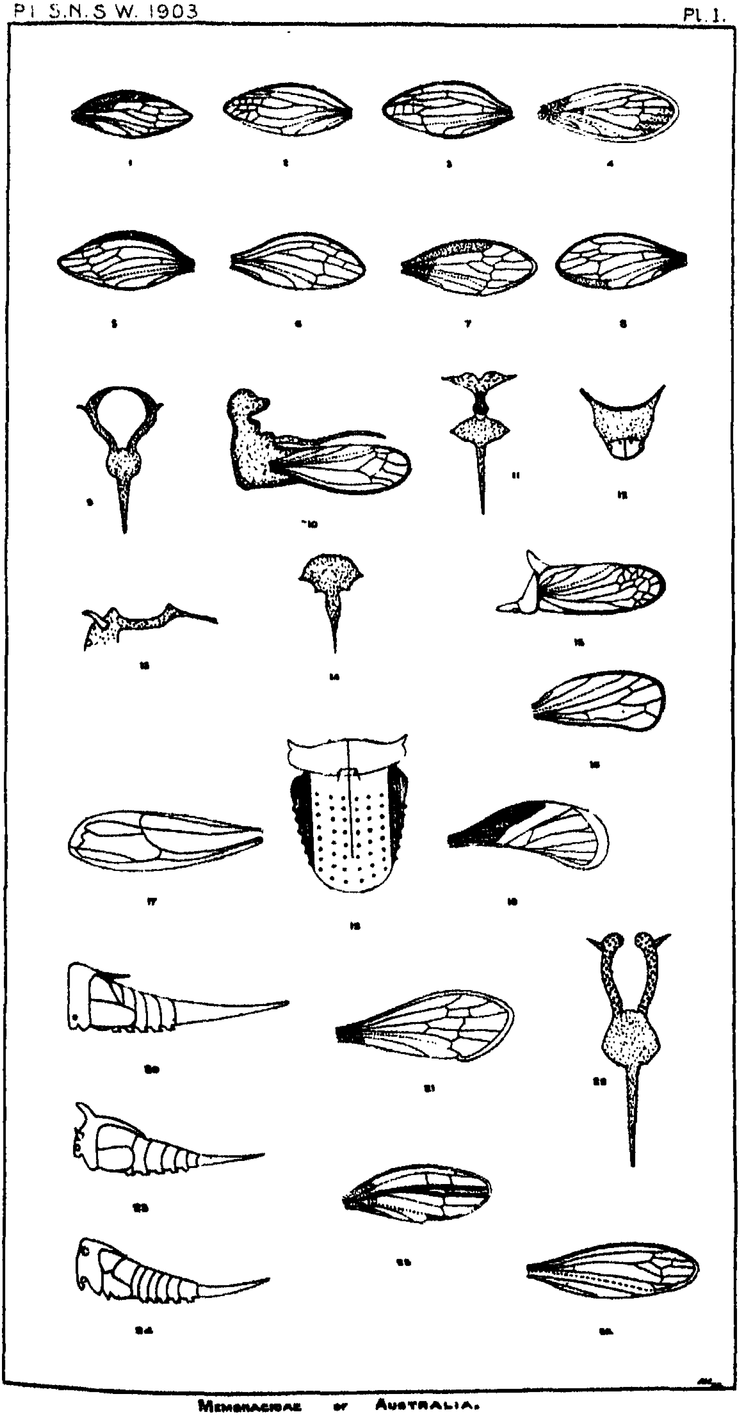
G. A. W. del.

AUSTRALIAN LYCÆNIDÆ

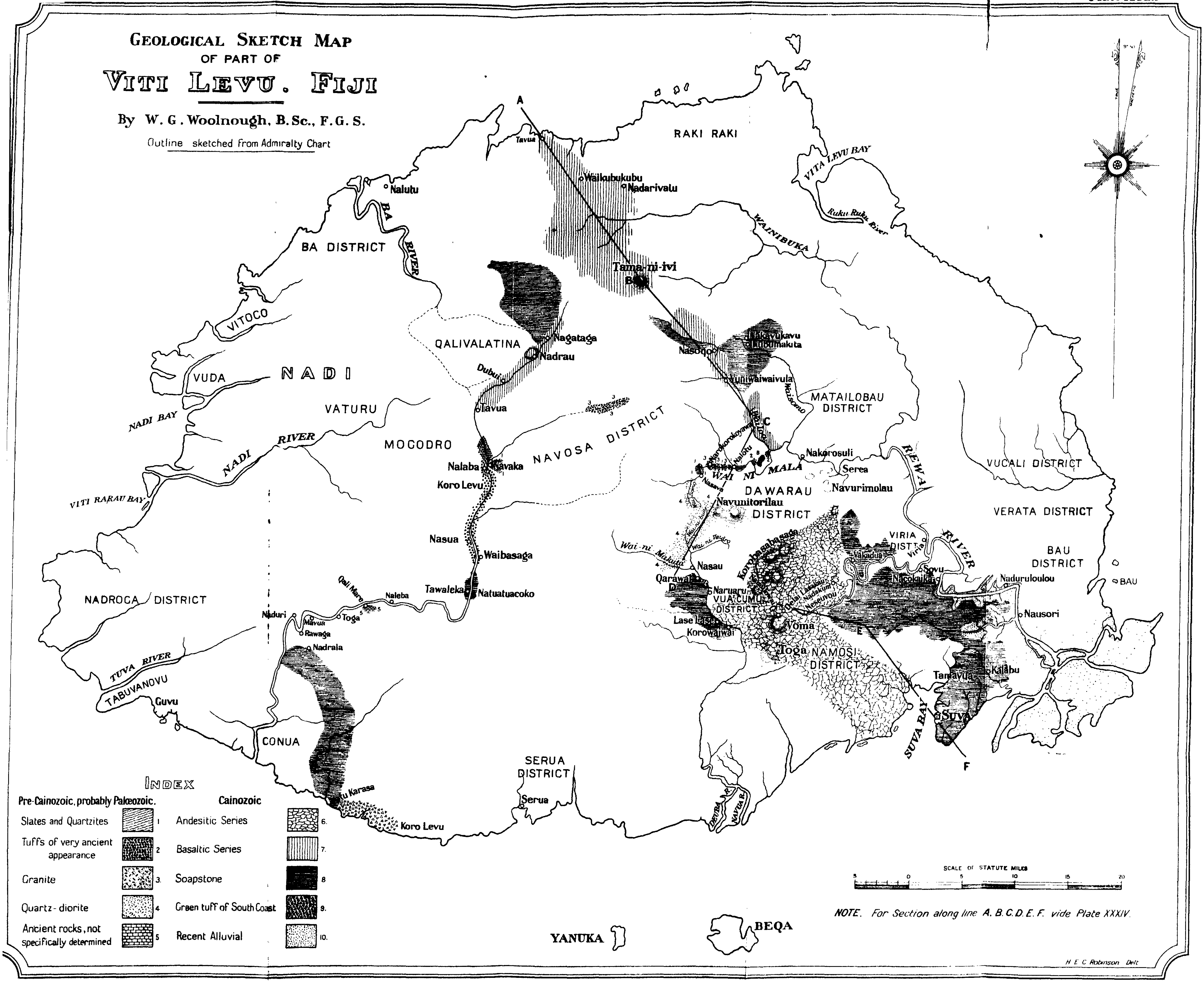


G.A.W. del.

AUSTRALIAN LYCÆNIDÆ



Membracidae of Australia.



Geological Sketch Map of part of Viti Levu, Fiji

By W. G. Woolnough, B.Sc., F.G.S.

Outline sketched from Admiralty Chart

NOTE. For Section along line A. B. C. D. E. F. vide Plate XXXIV.

H E C Robinson Delt

Highly Generalized Geological Section

ACROSS VITI LEVU. FIJI.

along the line A.B.C.D.E on plan (Plate XXXIII.)

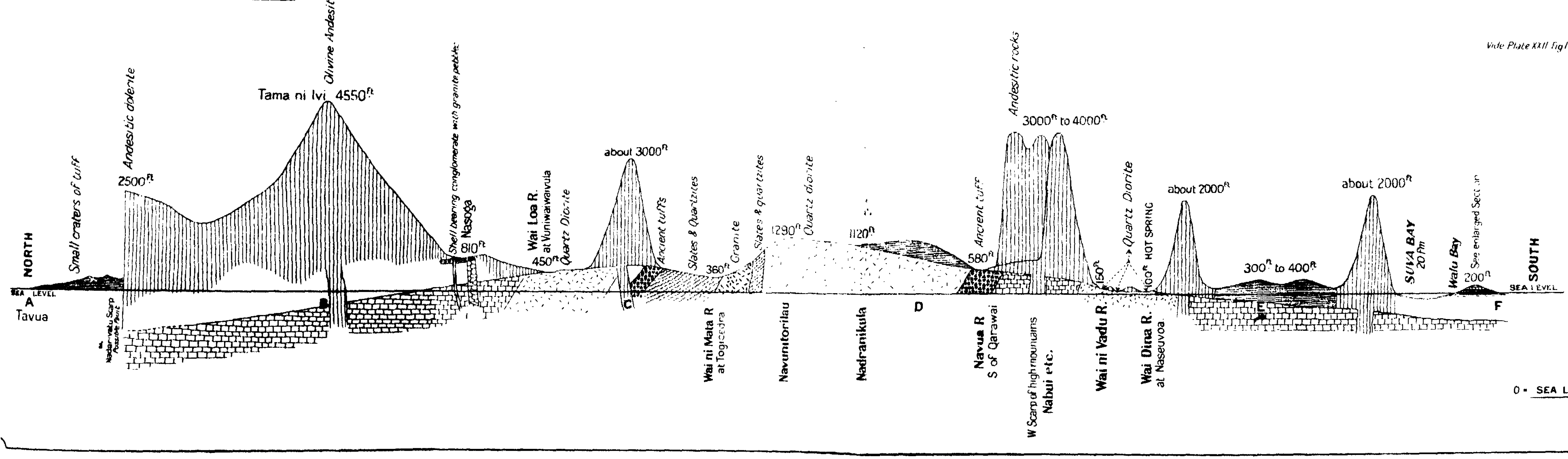
INDEX

PRE-CAINOZOIC probably PALŒOZOIC.

- *Slates and Quartzites.* ▨
- *Tuffs of very ancient appearance.* ▩
- *Granite.* ▒
- *Quartz diorite.* ░
- *Ancient rocks not specifically determined.* ▦

CAINOZOIC.

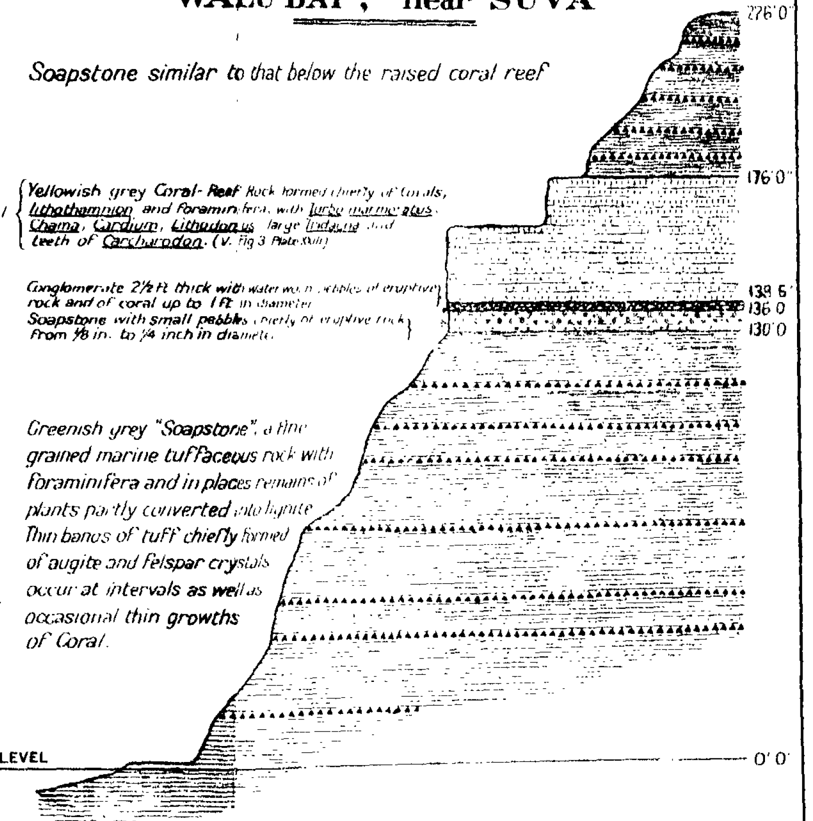
- *Andesitic Series* ▩
- *Basaltic Series* ▥
- *Soapstone with conglomerate containing pebbles of ancient rocks and Coralline limestone* ▤



SECTION

of Raised Coral Reef
interstratified with "Soapstone"
WALU BAY, near SUVA

Soapstone similar to that below the raised coral reef



Vide Plate XXII fig I

Yellowish grey Coral-Reef Rock formed chiefly of Corals, *Lithothamnion* and Foraminifera, with *Turbo marmoratus*, *Chama*, *Cardium*, *Lithodomus*, large *Tridacna* and teeth of *Carcharodon*. (V. fig 3 Plate XVIII)

Conglomerate 2½ ft. thick with water worn pebbles of eruptive rock and of coral up to 1 ft. in diameter

Soapstone with small pebbles chiefly of eruptive rock from ⅛ in. to ¼ inch in diameter.

Greenish grey "Soapstone", a fine grained marine tuffaceous rock with Foraminifera and in places remains of plants partly converted into lignite. Thin bands of tuff chiefly formed of augite and felspar crystals occur at intervals as well as occasional thin growths of Coral.

H.E.C. Robinson, delt.

Fig. 1.

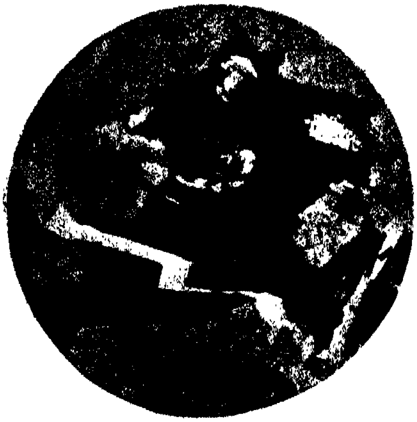
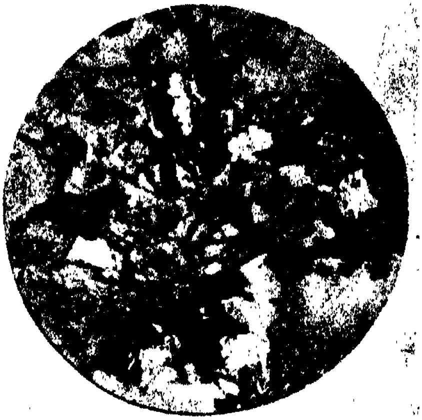
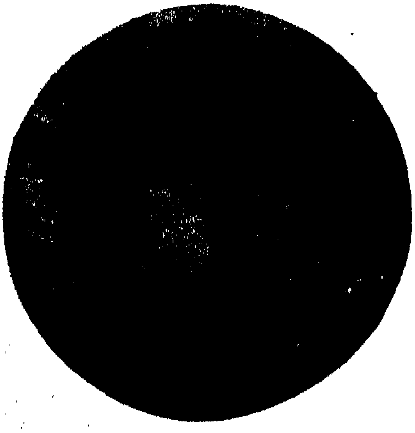
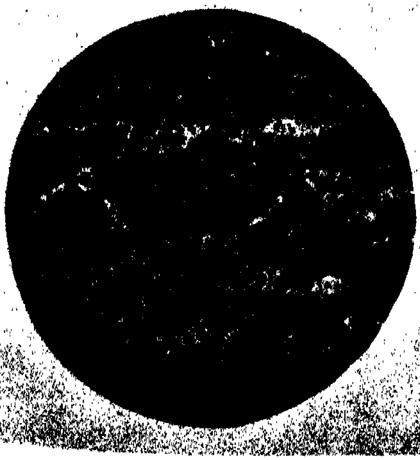


Fig. 2.







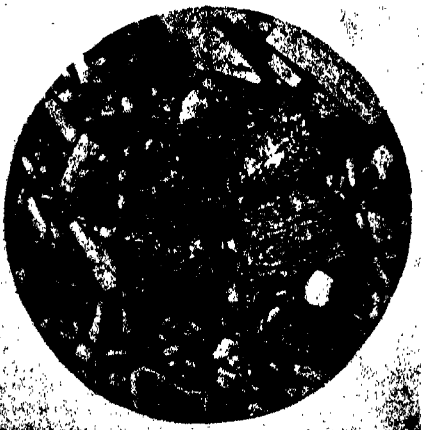


Fig 3. Fig. 5 (Central Figure). Fig. 4.

Fig. 1, GRANITE. Fig. 2, QUARTZ-DIORITE. Fig. 3, QUARTZITE. Fig. 4, AUGITE ANDESITE.
Fig. 5 (Central Figure), GLASS CAVITIES IN FELSPAR.

Fig. 6.

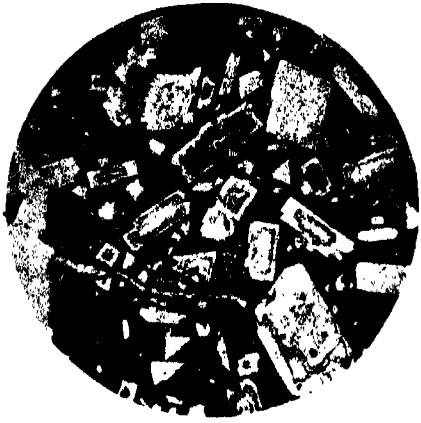
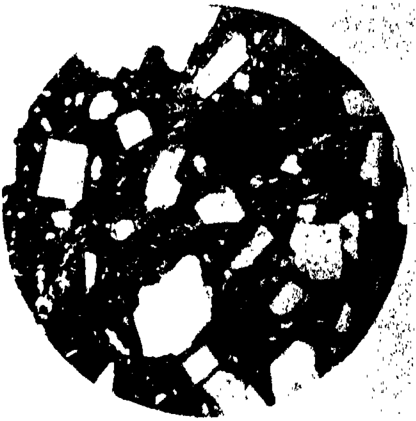


Fig. 7.



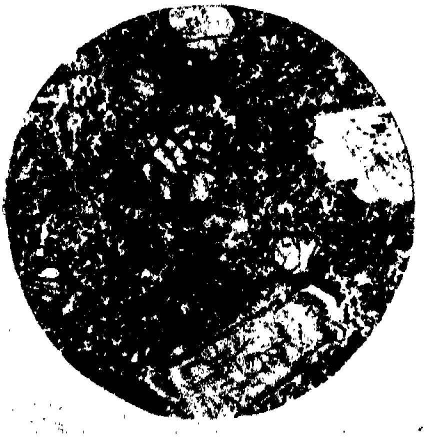


Fig. 8.

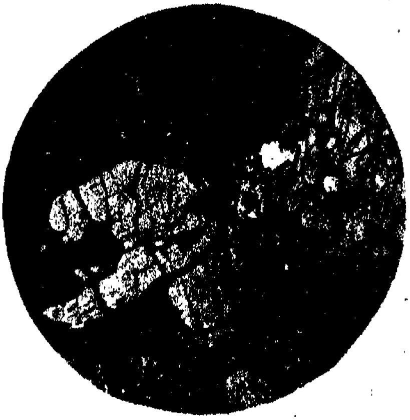
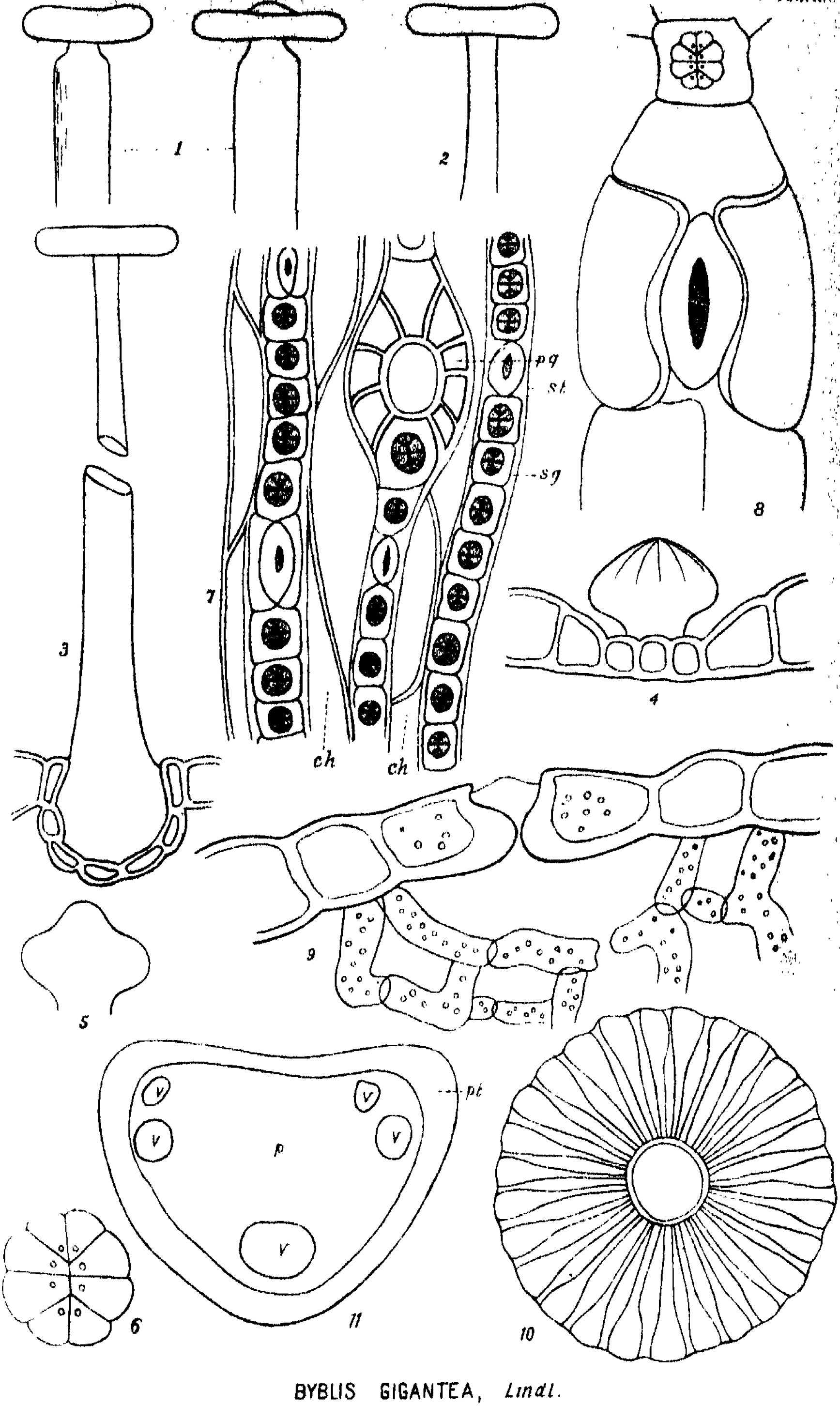
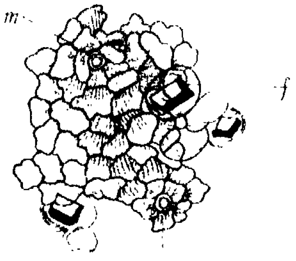


Fig. 9.

Fig. 6, HORNBLENDIC ANDESITE. Fig. 7, HORNBLENDE ANDESITE. Fig. 8, OLIVINE-BEARING ANDESITE.
Fig. 9, PORPHYRITIC BASALT.



BYBLIS GIGANTEA, *Lindl.*



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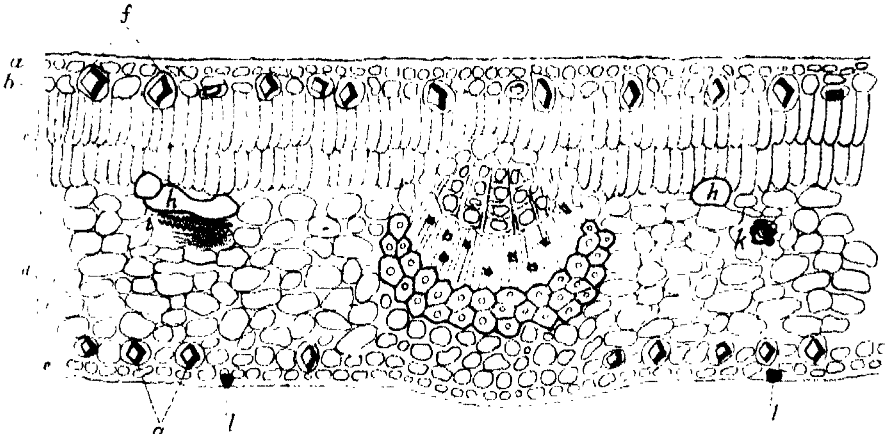

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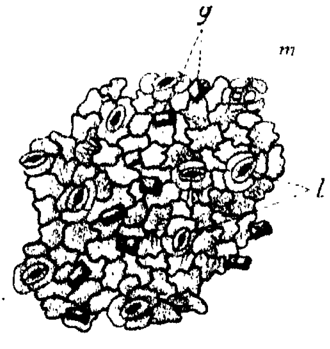
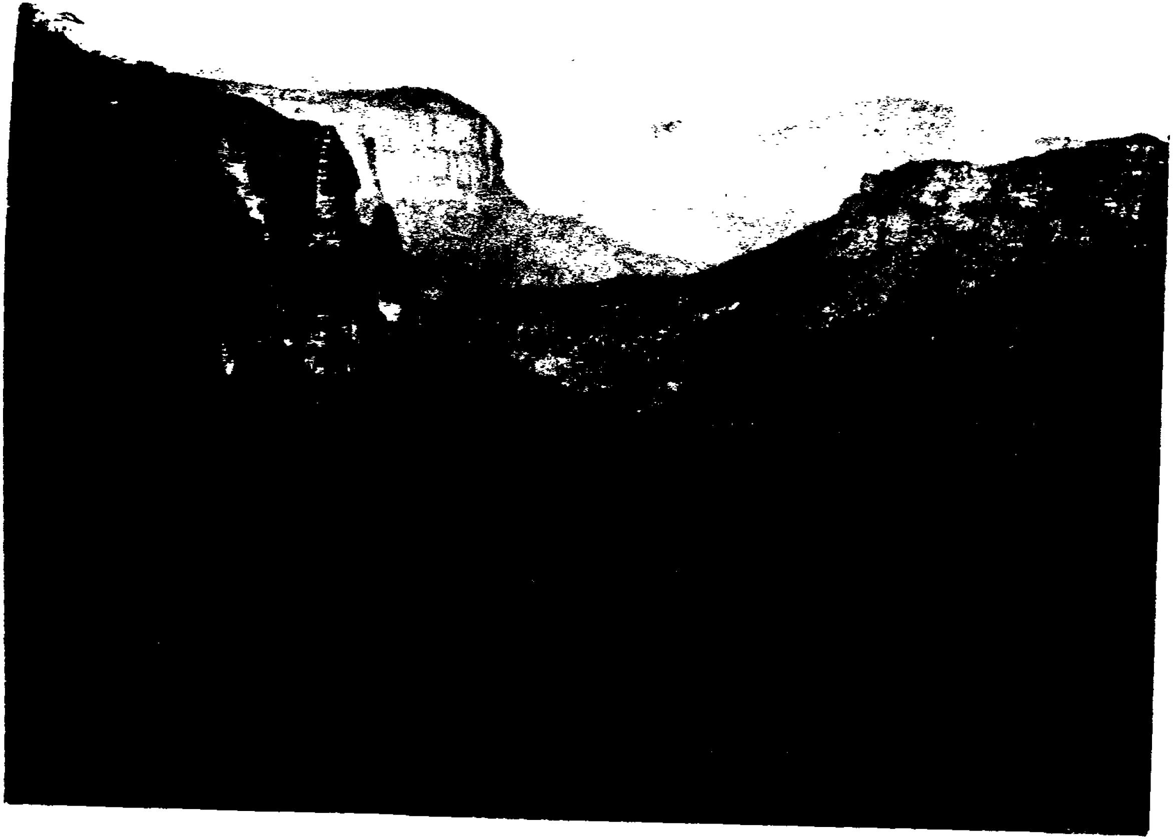


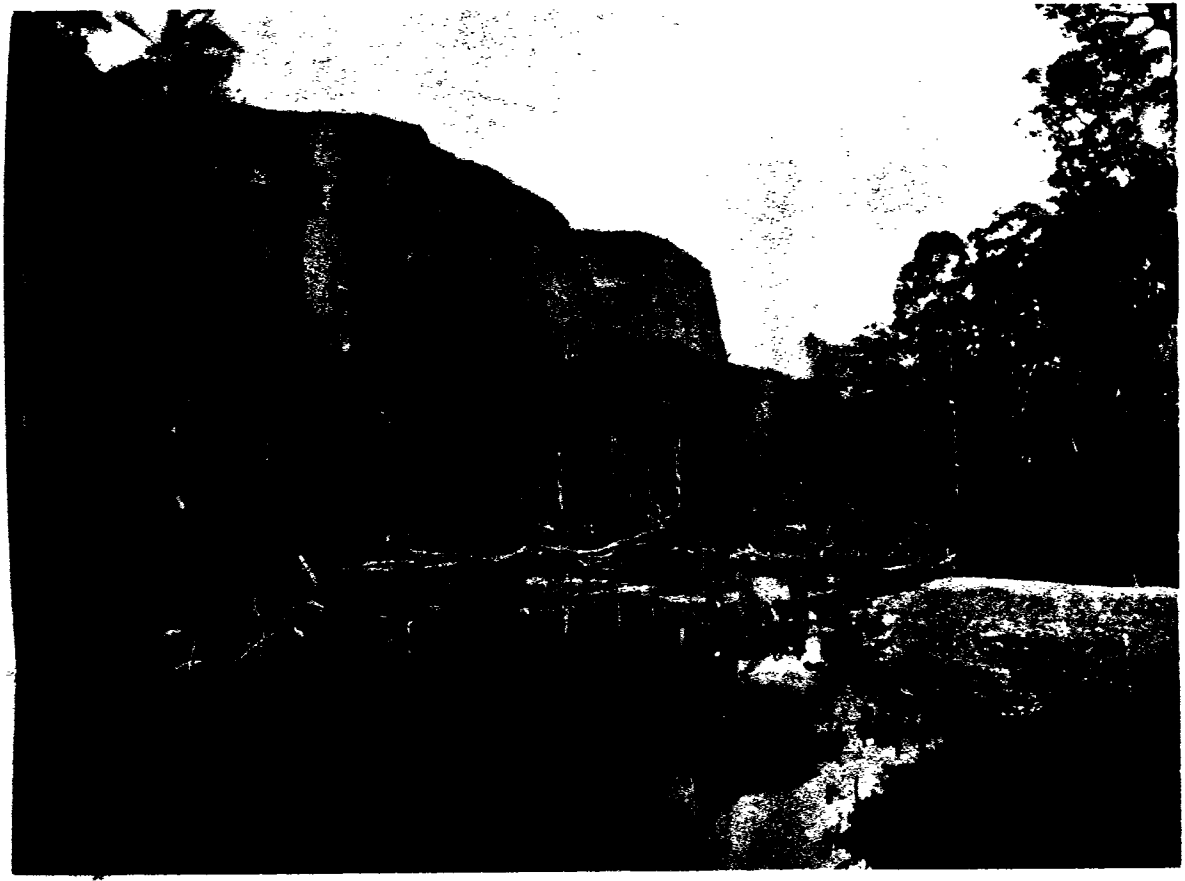
2

T. Herzog, del.

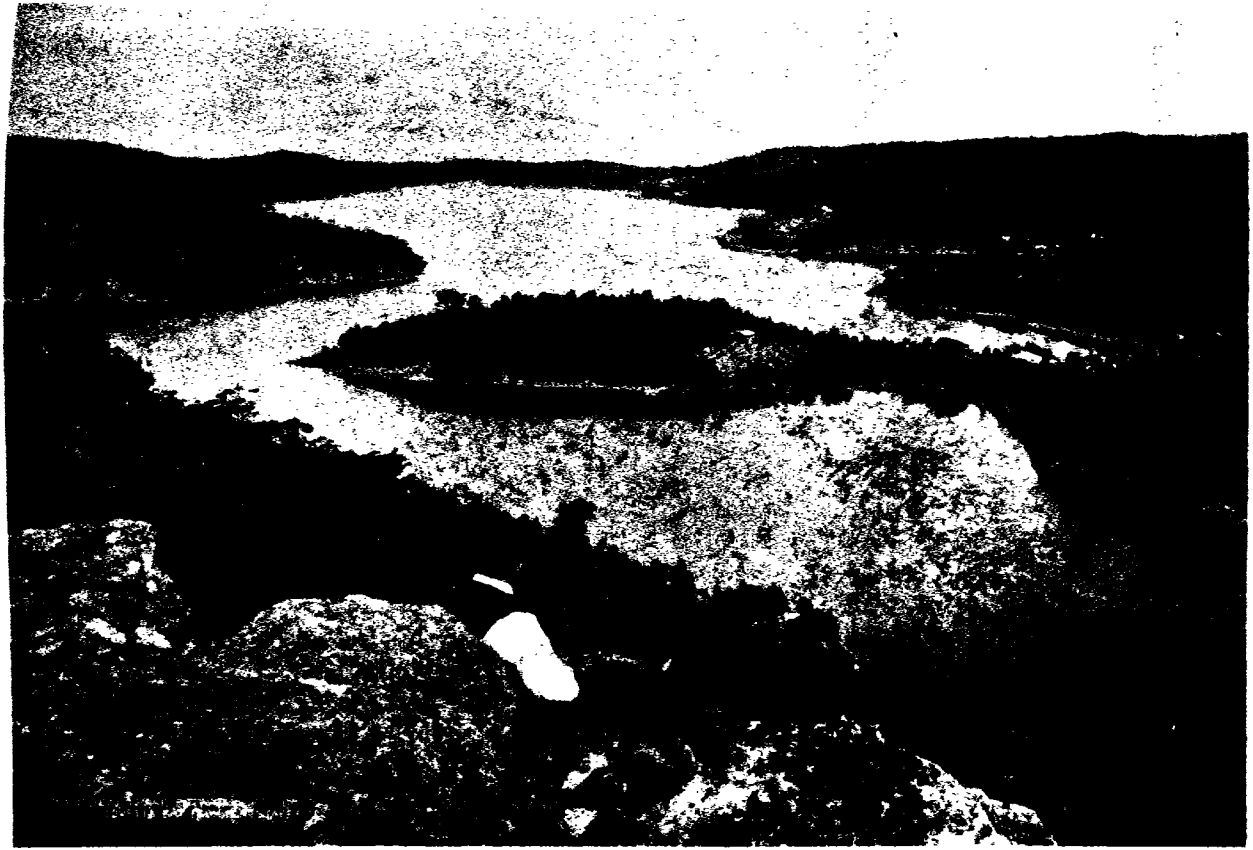
DYSOXYLON PATERSONIANUM, *Benth. & Hook. f.*



GOVETT'S LEAP, ILLUSTRATING CANON FORMATION.

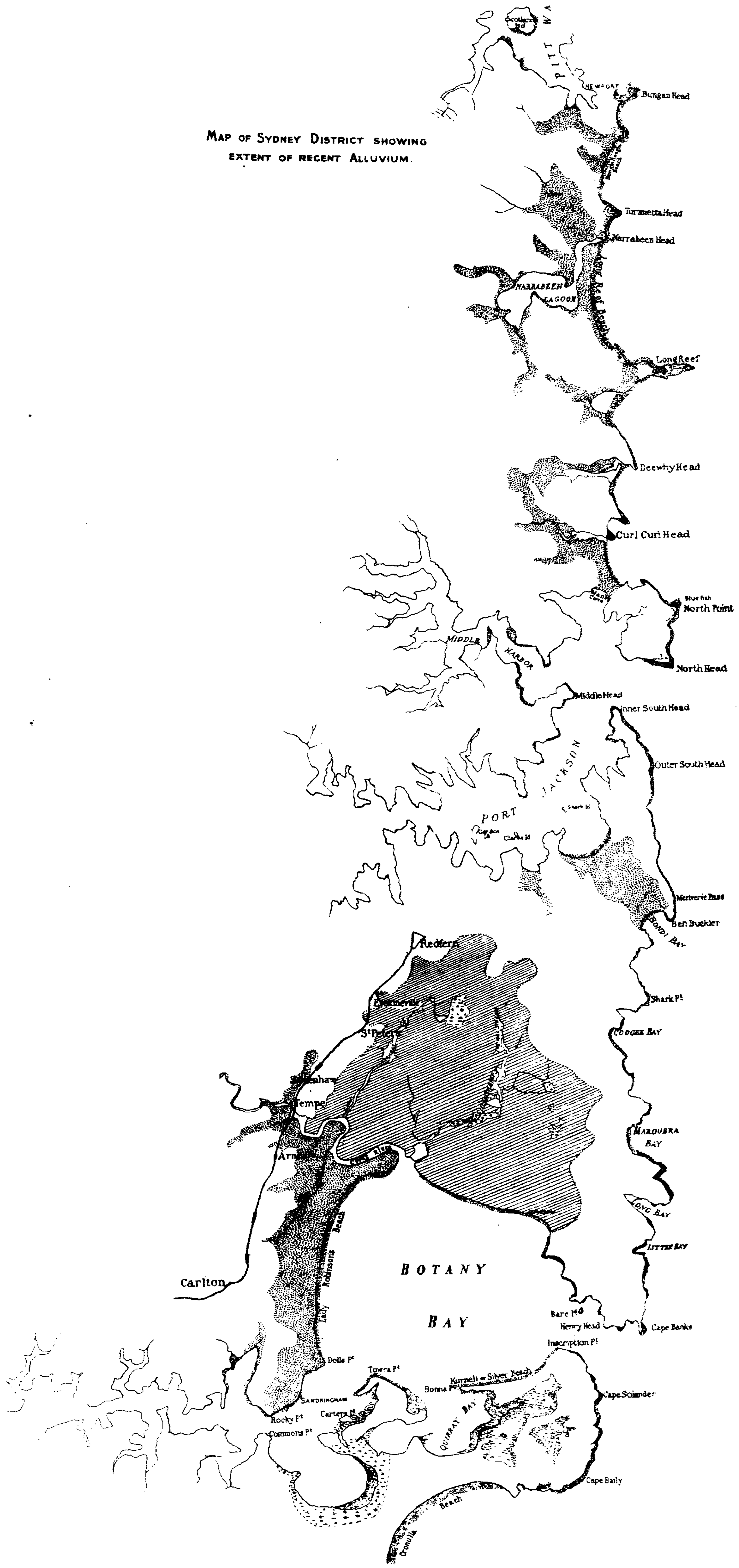


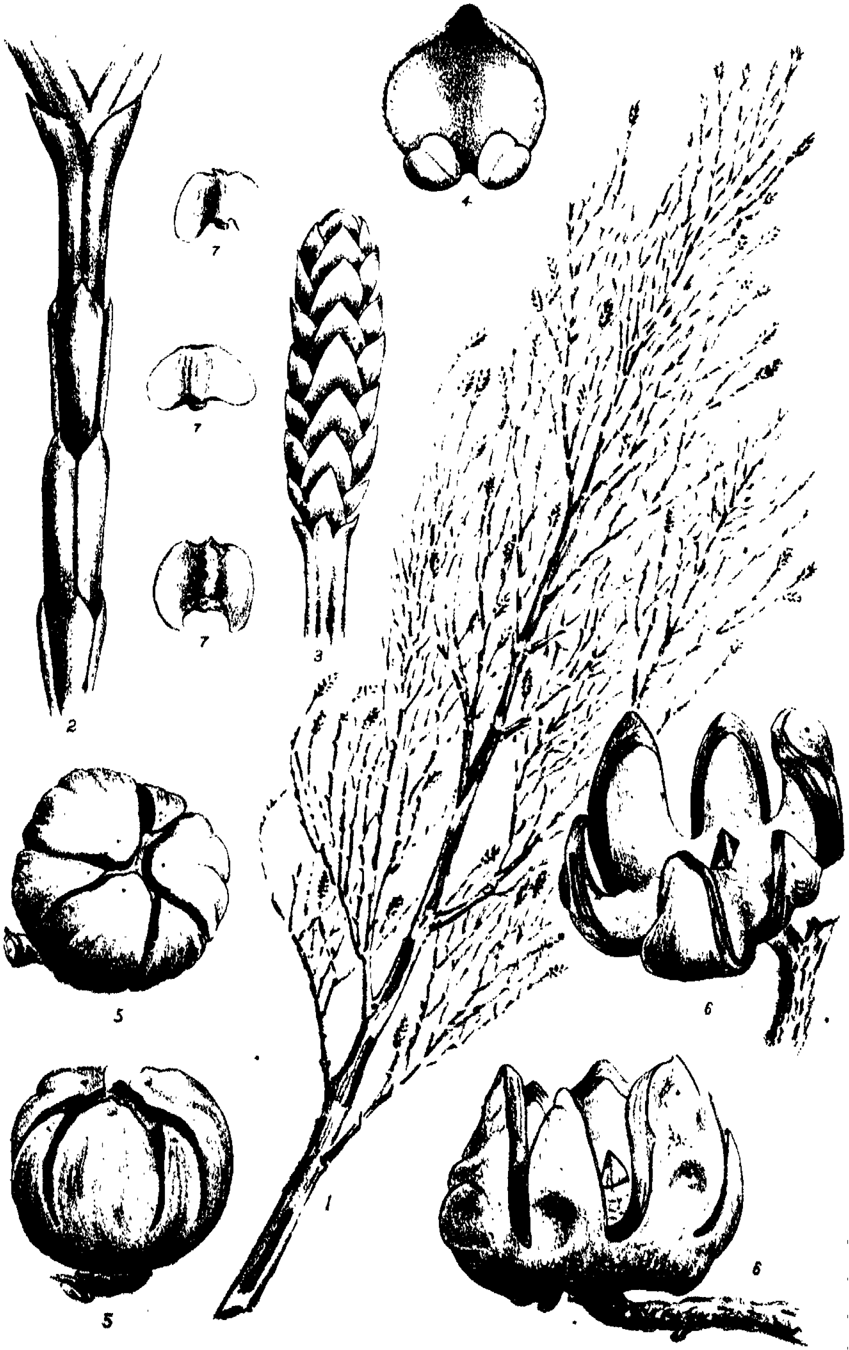
VALLEY OF THE GROSE, ILLUSTRATING DENUDATION DURING THE CANON CYCLE.



PITTWATER (LOWER HAWKESBURY), ILLUSTRATING DROWNED VALLEYS.

MAP OF SYDNEY DISTRICT SHOWING EXTENT OF RECENT ALLUVIUM.

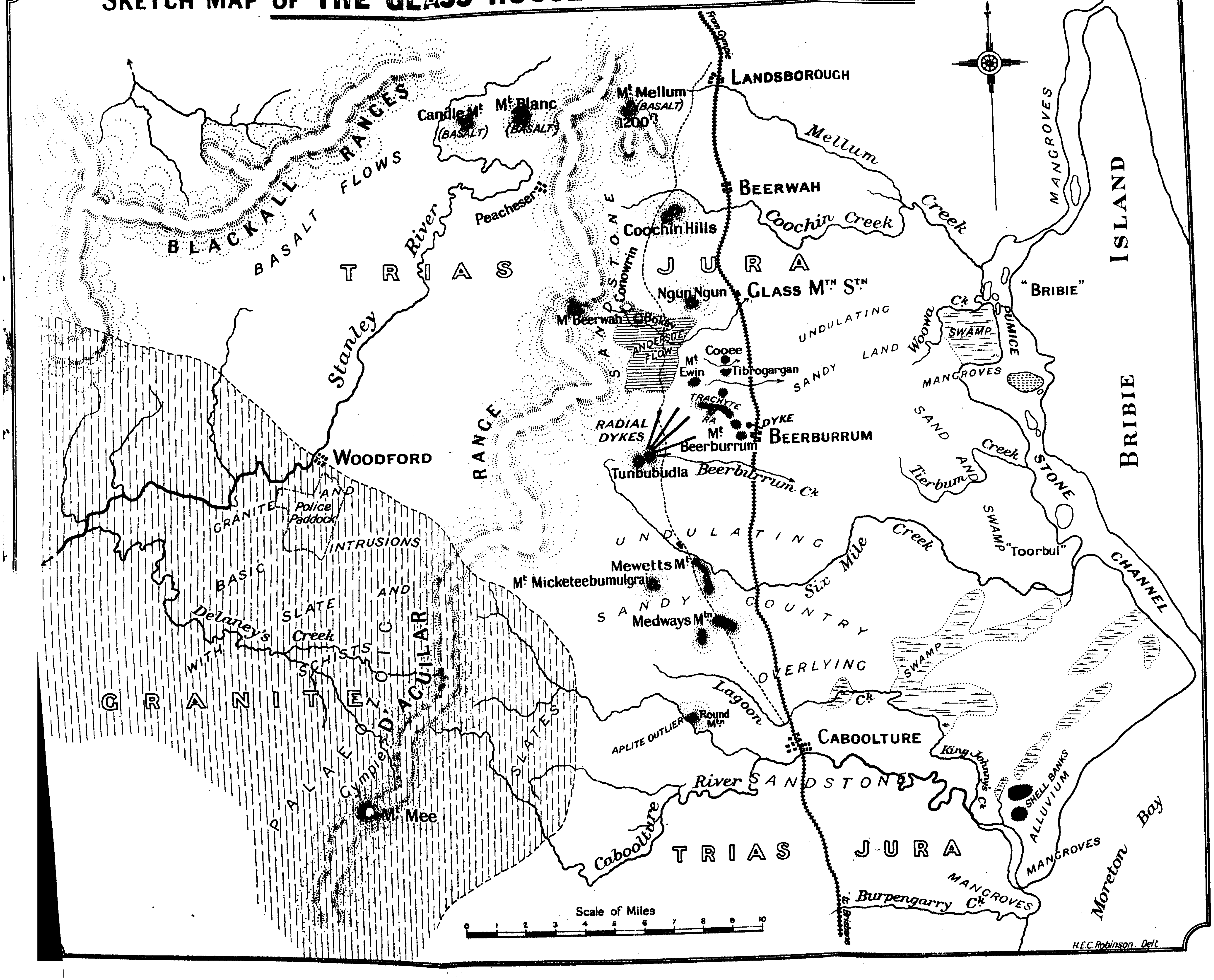




R.T.B. del. ad nat.

CALLITRIS GRACILIS, *sp. nov.*

SKETCH MAP OF THE GLASS HOUSE MOUNTAINS & DISTRICT. QUEENSLAND



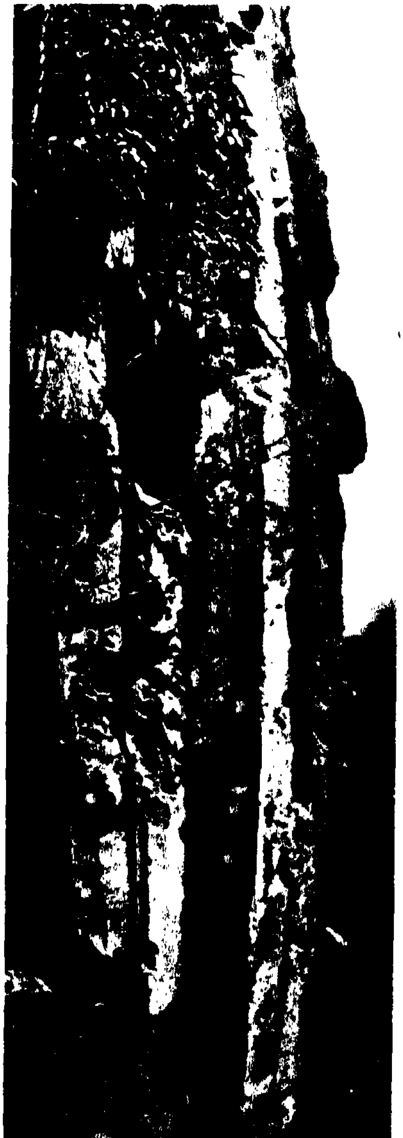


Fig. 1 COLUMNAR TRACHYTE (MT. CONOWRIN).

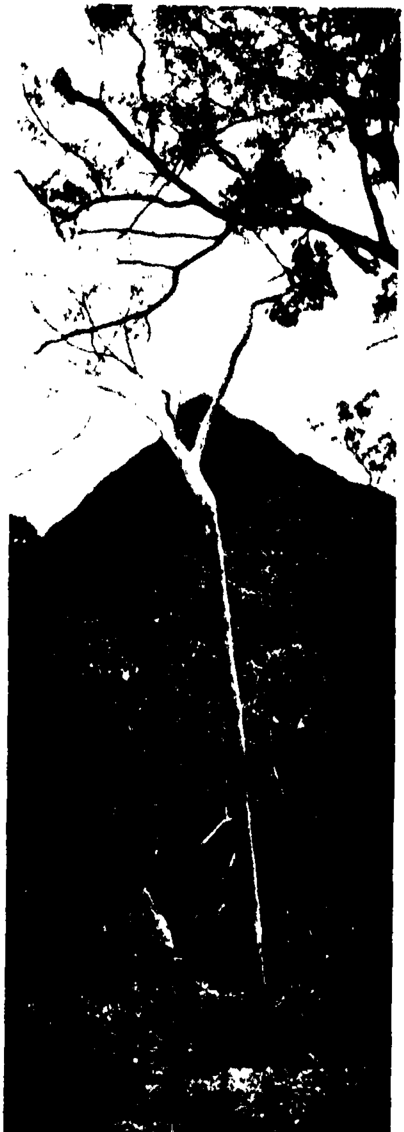


Fig. 2. MT. BEERWAH.

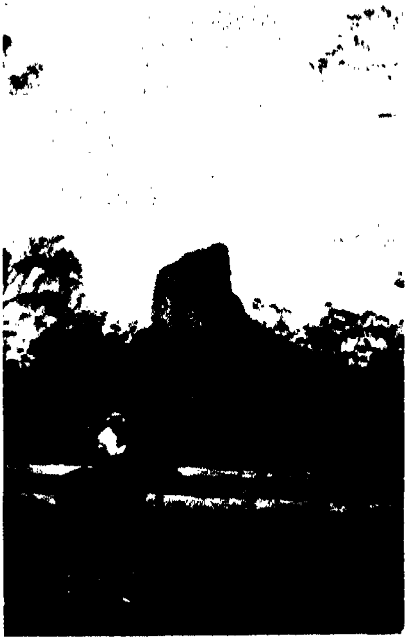


Fig. 3. MT. CONOWRIN.

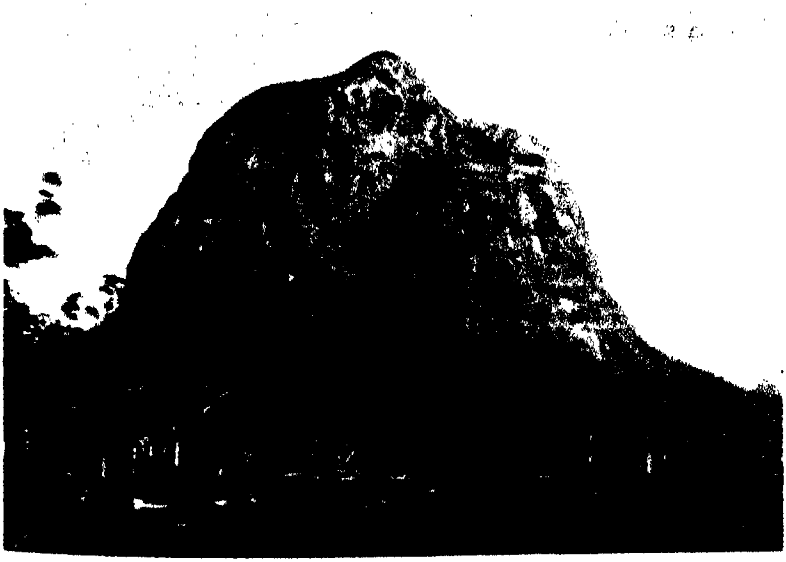


Fig. 4. MT. TIBROGARGAN (THE LINES REPRESENT TELEGRAPH WIRES).

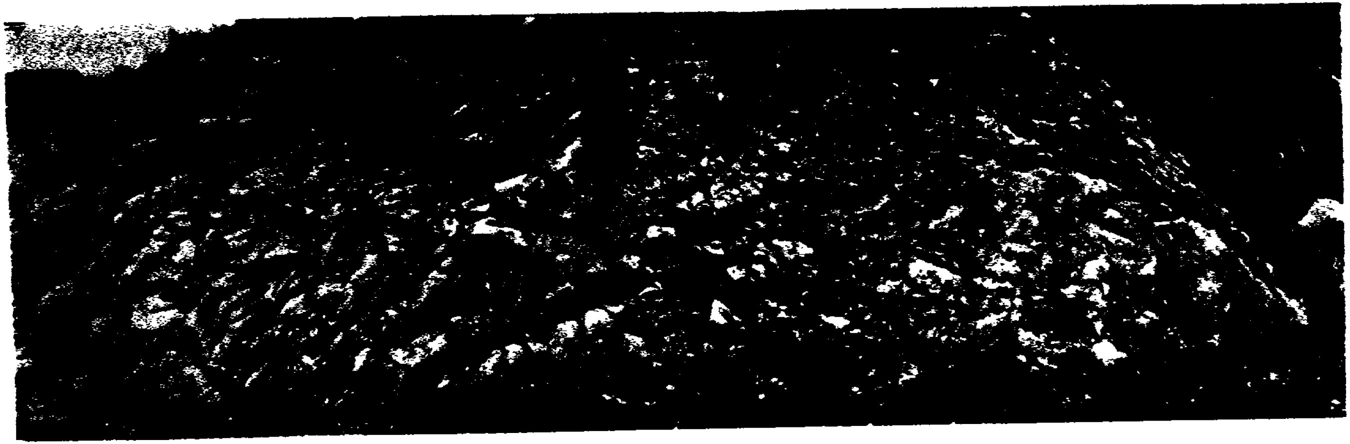


Fig. 5.—TRACHYTE DYKE CAUSING AN ANTICLINE.

Fig. 6.—BIRD'S-EYE VIEW FROM MT. NGUN NGUN.

Fig. 7.—BIRD'S-EYE VIEW FROM MT MELLUM.

I. A. R. I. 75.

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